

Vol. XXIV, No. 8

DECEMBER, 1957

THE SCIENCE TEACHER



JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION



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On October 4, 1957, a new word spun into the vocabularies of all Americans. The launching of *Sputnik*, the Soviet Union's earth satellite, has given those of us engaged in the work of education in the United States much more than just a new word. It has offered us a challenge without parallel in modern times. Perhaps no other single event has demonstrated so dramatically just how important science education in our schools has become to our national security and, indeed, to our very existence as a great nation. More than ever, it is time to show to the world how our dynamic, democratic system can respond to the challenge presented by the spectacular feats of Soviet science.

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Those of us directly engaged in education have long felt that the preservation of our free society depends on the classrooms of America. Since the Soviet Sputniks have been sent spinning into their orbits, public opinion has been aroused to the vital necessity of encouraging the youth of America to embark on careers in science. The public is now aware of the enormous responsibility of the individual teacher of science.

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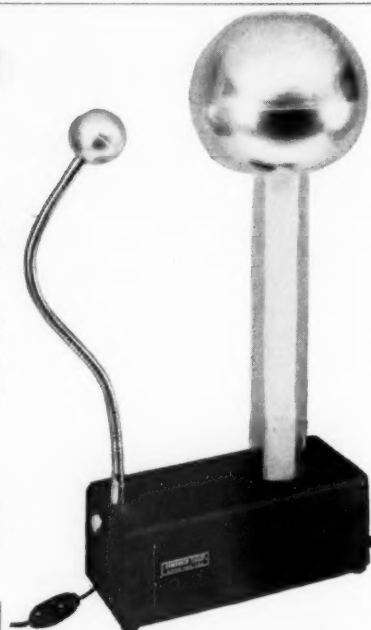
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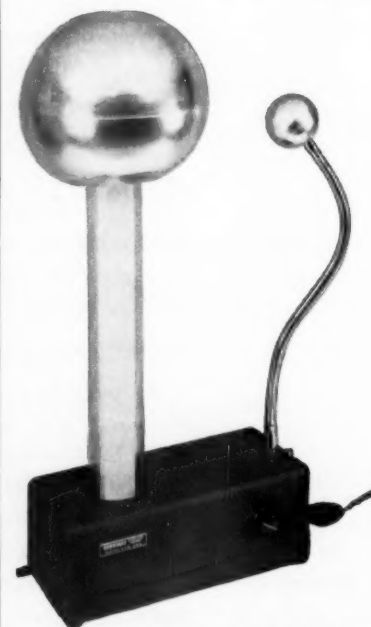
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The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

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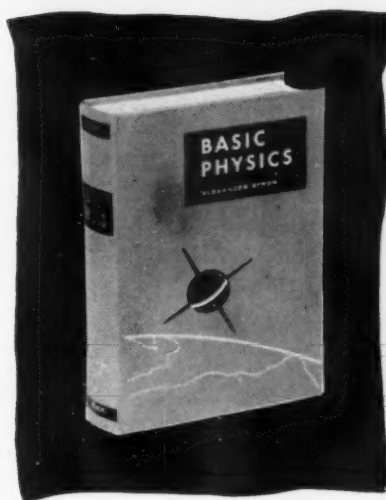
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REMINDER TO TST READERS AND SUBSCRIBERS

This is the last issue of Volume XXIV and of the calendar year. Publication will be resumed with the February 1958 issue which the editors plan to have in the mail for you by February 1.



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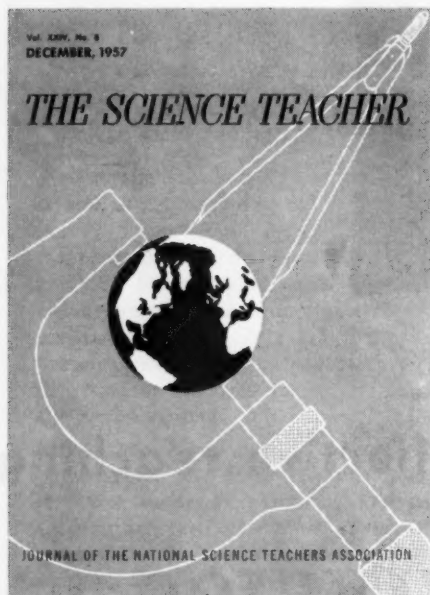


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THIS MONTH'S COVER . . .



symbolizes one of the important investigations currently being conducted in the International Geophysical Year program. Less headline-making than some other phases of the program, this one is operating in areas which can produce scientific knowledge of inestimable value. How and why are detailed in Maurice Ewing's article, "Earth, The Changing Laboratory," beginning on page 380 of this issue. It is the third in the series of articles on IGY activities being published in *The Science Teacher* during this international program. Reprints of the three and subsequent articles are and will be available; for information on how to obtain them (at no cost, in reasonable quantities), see page 367.

While IGY itself makes news, its offshoots and the consequent effects are beginning to be far-reaching. Two pieces in this issue bear this out. One is NSTA President Glenn Blough's article, "Children, Put Away Your Sputniks," on page 373; the other is Robert H. Carleton's editorial, "Scrutiny, Castigation, and Constructive Support . . .," on page 369.

Another special feature in this issue is Laurence H. Snyder's article, "The Rationality of Some Intuitive Foundation Stones," beginning on page 375. In this learned dissertation, Dr. Snyder uses his own field of genetics to demonstrate how intuition often becomes transformed into rationality.

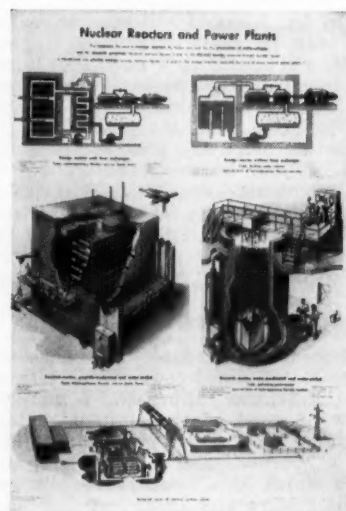
Winding up the calendar year, *TST's* editors present a variety of other subjects in this issue. Included is information on teacher-training programs developed through National Science Foundation grants for summer and academic-year institutes (page 395).

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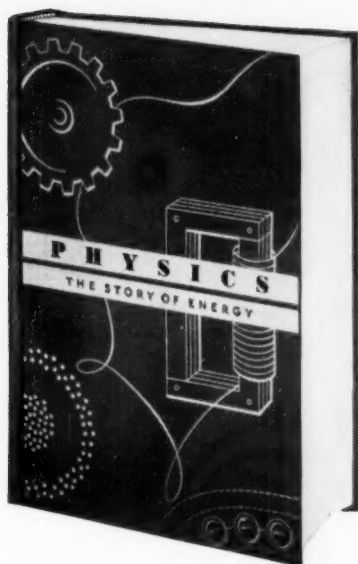
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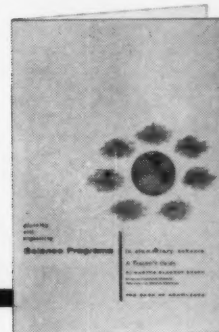
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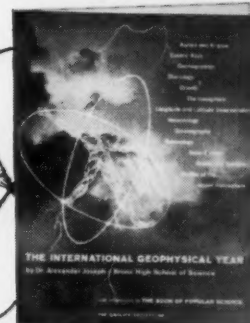
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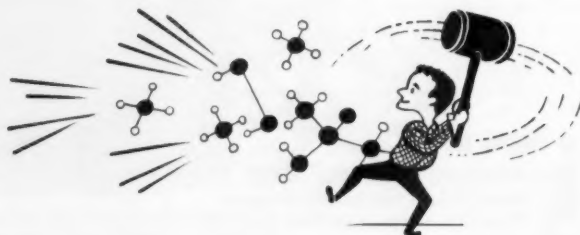
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Readers' Column

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2. The announcement about "The Strange Case of the Cosmic Rays" (Bell Telephone System TV Science Series) came just before Sputnik I. Our students were alerted to space interests. Thank you for the reminder of the splendid TV program.

3. The reprints from *The Science Teacher* (May 1957) of the article by Hugh Odishaw on "The International Geophysical Year" were sincerely appreciated by my science students. Some very interesting summaries of the article were written by 11th- and 12th-graders. Now, as a supplement, you send the THINK symposium on IGY. I have not yet had time to read it but it looks really interesting.

SISTER M. CLARICE, O.P.

San Gabriel, California, Mission High School

We have received more than 1300 individual requests for "You and Time" (a business-sponsored teaching aid for science published by the Bulova Watch Company, Inc.) as a result of your (special NSTA) mailing last spring. . . The total number of booklets requested exceeds 45,000.

We have received many complimentary letters from principals and curriculum supervisors. All of our correspondents have stressed the fact that "You and Time" seems to fit into the science curriculum. . .

I would like to take this opportunity to thank the members of the NSTA committee who advised us on "You and Time" during its preparatory stages. It certainly showed us that cooperation between education and industry is something quite real.

HAROLD L. RAPP

*Bulova Watch Company, Inc.
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I am grateful for the assistance the NSTA office, and especially Dr. John S. Richardson, extended to me earlier this year when I conducted a science institute in this area. The sets of materials you forwarded to me and the accompanying suggestions were both appreciated and most welcomed by the participants. We had a do-it-yourself type of program wherein the audience was given materials with which they could perform the "experiences" individually as various principles of

The SCIENCE TEACHER

science were discussed. The evening seemed to be worth-while to all—and a lot of fun.

GEORGE C. TURNER
Biology Teacher
Claremont, California, High School

I offer my sincere congratulations to the National Science Teachers Association for the plans which your organization has adopted to encourage research work by science teachers throughout the country. (See FSA Activities, page 408). I appreciate your organization's many worth-while projects which are aimed at improving the quality of science teaching in our schools.

ROLAND L. WOLCOTT
Superintendent
Wilton, Connecticut, Public Schools

With the enclosed check for \$4, please change my membership from regular to sustaining. I anticipate receiving selected mailings of teaching aids as my school has little equipment and money. My regret is that I did not learn of the Association before now. The sample copies were excellent and contained information which I needed.

RAY A. WALTER
Waco, Texas

As a new member of the Association, I am very pleased with the first two issues of *The Science Teacher*. Ideas contained in those issues have already been put into practice.

E. LABINAWICH
Winnipeg, Manitoba, Canada

We want to congratulate the Association and, in particular, the Elementary School Science Committee, for and on several things:

1. Because you have Dr. Glenn Blough as your president. He is an unusually fine man and a wonderful leader. We have known him for years and hold him in very affectionate regard.

2. Because of the fine publication, *Elementary School Science Bulletin*. We have read the October issue and commend you highly on its contents.

We wish you much success at your convention to be held in Denver in 1958 (March 26-29). More power to your group!

HARRIETT M. CHASE
Chief Assistant Emeritus to the
Executive Secretary, National Education Association
EVA G. PINKSTON
Executive Secretary Emeritus
Department of Elementary School Principals, NEA
Washington, D. C.

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Mr. Arnold Frutkin, International Geophysical Year, National Academy of Sciences, Washington 25, D.C.

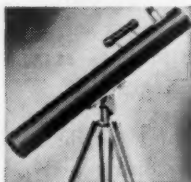
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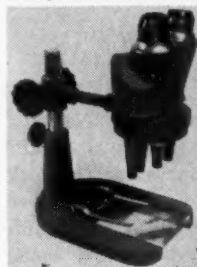
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SCRUTINY, CASTIGATION, AND CONSTRUCTIVE SUPPORT . . .

By ROBERT H. CARLETON

Executive Secretary, National Science Teachers Association, Washington, D. C.

JUDGING by what I read and hear in the wake of Sputniks I and II, courses and instruction in high school science are due, in the months ahead, for scrutiny, castigation, and constructive support on a scale not witnessed ever before.

It is an accepted fact that these are critical times. The sputniks have shaken us out of our complacent attitudes toward schools and teachers. It is not unlikely that decisions will soon be made which will affect American education for years to come. *We need prompt action* to produce the soundest decisions possible—ones that we shall not regret five, ten, or 20 years hence.

When Congress reconvenes in January, we shall undoubtedly see a flood of bills designed to improve the situation. Federal action toward this end could be good, or not so good, in my opinion, depending on the degree to which three facts are kept in perspective:

- I. We cannot buy overnight by "crash programs" what we have been asking for but have been unwilling to pay for during at least a quarter of a century.
- II. The classroom teacher is the key to progress and improvement in the instruction and motivation of young people to understand science and to consider careers in this field.
- III. Science teaching and science teachers are not "something apart," but are and *must be* integral parts of the total educative endeavor.

What is it, then, that science teachers have been asking for and desperately need today in order to fulfill their responsibilities in meeting the challenge of Soviet education, science, and technology?

Here is my attempt to identify certain items of high priority and to suggest major responsibility for leadership and financial support essential to their attainment. My judgment is based on policy actions and statements of the Board of Directors of the National Science Teachers Association and on correspondence with teachers and leaders in science education in the field.

1. REASONABLE TEACHING SCHEDULES AND NONTEACHING ASSIGNMENTS. The

high school science teacher today not uncommonly handles five or six classes a day in three or four different subject matter fields and with as many as 35 to 45 students per class. In addition, he may supervise the lunchroom, help coach football, sponsor the school science club and science fair, and administer the school's audio-visual education program. The absolute maximum for any teacher from whom we expect, and should demand, top performance should be about 100 students in four or five classes and in not more than two different preparations each day. The teacher's "extra time" beyond classes should be available for working with individual students who show special science interests or aptitudes, and for general planning and strengthening of the science program. Other personnel such as teachers' aides should be employed to coach, supervise the lunchroom, administer the audio-visual program, teach driver education, and the like.

The responsibility for determined, irresistible action to achieve these conditions rests with local Boards of Education and citizens' groups.

2. GREATLY IMPROVED SALARY SCHEDULES TO ATTRACT AND RETAIN CAPABLE TEACHERS.

It is a national disgrace that in 1955-56 the median salary for all secondary school teachers was only \$4350, and only \$3800 for elementary school teachers. In today's economy, professionally prepared teachers should start at not less than about \$5000 and should advance to at least \$7500 in not more than ten years; they should enjoy the prospect of a "top" salary of at least \$11,000.

Again, local Boards of Education, citizens' groups, and state legislatures have major responsibility to plan and campaign for action to achieve these goals. Federal funds, even if limited to school construction, could release large sums of local dollars for this purpose. Such groups as the U. S. Chamber of Commerce should lead and invite local Chambers to join in campaigning FOR such support for schools, not just campaign AGAINST federal assistance.

3. IMPROVED FACILITIES AND EQUIPMENT AND ADEQUATE SUPPLIES. The proper, resourceful teaching of science is expensive, compared to some other fields of education. But efforts to teach science without adequate laboratory and demonstration equipment deprive students of experiences with the very heart and soul of the scientific endeavor.

A program of federal aid for this purpose could be very helpful. Provision of only \$500 per high school, on the average, would total only about \$12.5 million. The administration of this fund might be channeled through the U. S. Office of Education and the state Departments of Education.

4. IMPROVED SUPERVISION AND COORDINATION OF THE SCIENCE PROGRAM IN GRADES 1-12. There is great need for larger numbers of specially trained consultants and supervisors for science in the elementary schools. Only a small fraction of the local school systems and not more than half a dozen state Departments of Education have anyone specifically designated as a supervisor, coordinator, or consultant for science in secondary schools.

This area would seem to be another appropriate avenue for federal aid to schools. Funds could be released through the U. S. Office of Education to state Departments of Education and to colleges and universities. An average of \$250,000 per state would cost the U.S. Government only about \$12.5 million.

5. OPPORTUNITIES FOR SCIENCE TEACHERS TO UPDATE THEIR KNOWLEDGE OF SUBJECT MATTER AND TECHNIQUES OF TEACHING. Teachers are enthusiastic and eager for such opportunities, but they need financial aid if they must forego summer earning opportunities for this purpose. Recent years have witnessed highly satisfactory cooperation by departments of education and science in the colleges and universities in designing realistic and helpful programs of instruction.

The federal government can stimulate and assist in this area by two principal kinds of action: First, by passing legislation to allow income tax deductions for funds spent by teachers to take in-service and summer courses for self-improvement; e.g., the King-Jenkins Bill, HR 4662; second, by continuing the summer institutes program now provided through grants by the National Science Foundation. Financial aid to provide \$1000

per teacher for 5000 teachers each summer adds up to \$5 million. This, too, would seem to be an appropriate area, perhaps the most appropriate, for industry to lend its support. Business-industry should continue to make grants for special summer programs for science teachers and supervisors.

6. CURRICULUM RESEARCH AND DEVELOPMENT. Tradition and legislation in our country place responsibility for educational programs on the state and local school systems. Increasingly, however, teachers and schoolmen are asking for advice and help of several kinds as they seek to revise course content and to redesign the science curriculum in line with modern developments.

Educational foundations and perhaps the federal government should provide funds to enable this important kind of work to move forward. The National Science Teachers Association has a major responsibility and unique opportunities to provide stimulation and leadership in this field. What is lacking and is needed, however, is about \$1 million a year—for at least five years. NSTA has unmatched connections with schools, science teachers, and other educational and scientific groups, from among which adequate numbers of highly competent persons can be secured to plan and carry out a really significant program of curriculum research.

7. EXPANSION OF THE SCIENCE STAFF OF THE U. S. OFFICE OF EDUCATION. The present staff of one specialist for engineering education, one for college-level physical science, one for high school science, and less than one-quarter of a specialist for elementary school science is an anemic, wholly inadequate gesture by the federal government to meet its responsibilities in the present crisis.

If the programs and responsibilities suggested above are to be assigned to the U. S. Office of Education, its science education staff should be expanded probably 15- to 20-fold.

8. SCHOLARSHIPS FOR HIGH SCHOOL GRADUATES AND COLLEGE STUDENTS. A program of scholarship aid would affect the quality of instruction only indirectly, but should stimulate, motivate, and assist a much higher proportion of our able high school graduates to enter college and go on to the completion of degree programs. In recent years, according to the Research Division of the National Education Association, only about one in four high school graduates enters college and

stays on to complete the bachelor's degree; about one in five or six holders of the bachelor's degree completes a master's degree program; and about one in seven or eight master's degree graduates completes a doctorate.

School and college officials should take action to develop a sound, workable program of scholarships and fellowships supported by financial grants from philanthropic foundations, industry, and possibly the federal government. (See West, Elmer D., Editor, Background for a National Scholarship Policy. American Council on Education, 1956, Washington, D. C.)

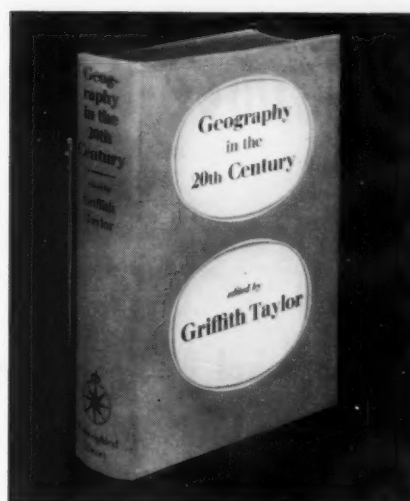
In the light of present-day events, I am confident that the eight suggestions offered above would have the enthusiastic support of the great majority of NSTA's more than 10,000 members—typical classroom science teachers in elementary schools, high schools, and colleges and universities. These suggestions are herewith offered for further consideration and reaction by those who read this column. Reprints are being sent to all members of the U. S. Senate and House of Representatives.

IGY Television Series

Titled "A Small Planet Takes a Look at Itself," a series of ten TV programs designed to explain various phases of the International Geophysical Year program are available to classroom teachers. Featured on educational TV networks, the programs have also been shown on commercial stations. Kinescopes of the series are still being programmed in different areas of the country. Check your local NBC-TV station to determine if yours is one of these areas.

Kinescopes may also be borrowed by teachers for classroom or group study use. Write to Mr. Donley Feddersen, Educational Radio and TV Workshop, Ann Arbor, Michigan.

Each of the ten programs features one or two guests who are leaders in their fields related to IGY activities. The ten programs, which run 30 minutes each, are: (1) The Quest, (2) The Oceans, (3) The Ends of the Earth, (4) The Face of the Land, (5) The Trembling Earth, (6) The Weather, (7) The Air: Blanket and Shield, (8) The Sun, (9) Higher Than the Blue Sky, and (10) New Moons.



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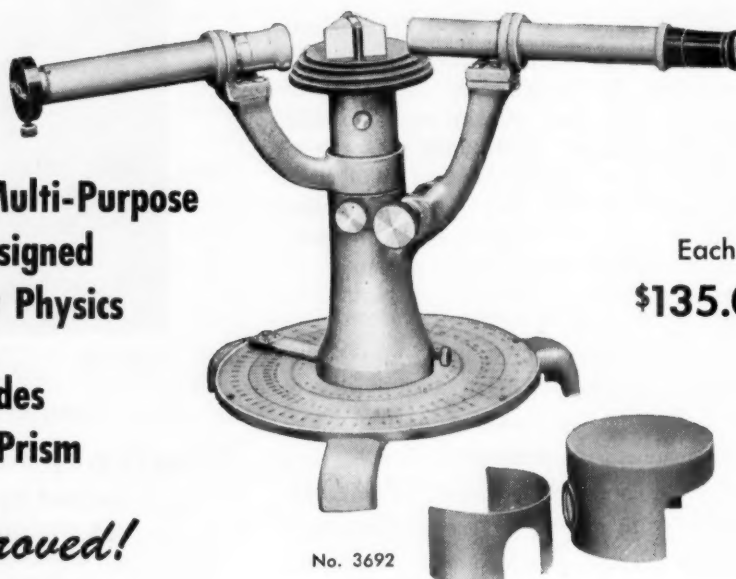
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Children, Put Away Your Sputniks

By GLENN O. BLOUGH

Associate Professor of Education, University of Maryland, College Park
President, National Science Teachers Association

IT was the Monday after the Russians launched their first satellite. The children in Miss Alvin's fourth grade assembled as always to "plan for our day." There was more than usual eagerness in the room and several pupils were equipped with pictures of the sputnik and clippings from the newspapers. But do you know what went into the daily plans? "*We will learn more about birds.*"

The sputnik clippings were put away for another time because, as Miss Alvin says, "Each autumn my fourth grade has such a lovely time with birds." Miss Alvin's class has been having a "lovely time with birds" every October for years and years. They have learned to identify *from pictures* several common birds; they have made crayon pictures of blue jays, cardinals, and robins; they have *copied* from available sources the data about the birds' habitat, description, and size into their booklets. They did almost the same thing last year in the third grade because Miss Allen, their third grade teacher, likes birds too. It hardly worries Miss Alvin at all that the children never *see the birds* they talk about—or that the information they get about them is almost useless, that the pictures they draw have no semblance of accuracy, and that the chil-

dren are studying birds because she wants them to and are repeating what they have already had in a previous grade.

The time for discussing sputniks probably will never come in Miss Alvin's room. Neither will it in hundreds and hundreds of other elementary schoolrooms in the United States because there are about as many schools without a respectable science program in the United States as there are with one, probably more.

There is much discussion these days about keeping up with other countries on science education. There is much soul-searching to discover if we are actually behind Russia in science teaching. More fundamental, perhaps, is the question of whether or not we are keeping up with today's children. In science we are, in hundreds of elementary schoolrooms, living still in the age of the bustle and the blacksmith. Suddenly there has been a jolt. Perhaps a healthy one.

Just what does the recent furor of emphasis on science mean for the elementary school? We are told that our country is deficient in the production of scientists, that there will be an increasing demand for science-trained personnel, that not enough high

school pupils are electing science, that these conditions can have far-reaching and disastrous results. What implications have these for the grade school? Plenty.

But first, here are *two* things that they do *not* mean: We are not expected to build the whole elementary school program around science; nor are we being urged to make the smartest ten-year olds become scientists if they do not wish to do so.

They *do* mean, however, that in the majority of elementary schools the science program is totally inadequate to meet today's needs and interests of children and that our progress to remedy this situation should be greatly accelerated. The science teaching in our elementary schools, except for some notable exceptions (and these are growing in number), is years behind the times. The content, organization, and methods of instruction are totally inadequate in a large number of schools.

If we are ever to catch up with the interests and needs of today's children we must have:

1. *Carefully planned, sequential courses of study in science just as we have in other areas in the elementary school.* There is no reason to expect that we can build a meaningful science curriculum for today's children around cocoons, rocks, and hickory nuts dragged in by the children and deposited on the science table. Nor can it be built around incidental questions children sometimes ask for one reason or another. A planned course will do away with useless repetition and will insure that pupils are introduced to the great variety of science problems that are part of their environment. There can still be room for considering children's questions and using teachers' initiative within the course framework.

2. *Teachers who realize that they themselves live in this modern age of science and consequently must inform themselves of the subject matter.* Women live in this age as much as men do. As long as the large percentage of elementary teachers are women, they must feel obligated to become informed to shoulder the responsibility that they assume when they decide to teach children. The day has passed when we can afford to say our elementary teachers do not know anything about the environment in which they live. As long as this is true, they are unprepared to teach today's children. This does not mean that elementary teachers need to be scientists themselves. It *does* mean that they must be at least as informed in science as well as we hope the knowledgeable citizen is. To help teachers catch up, we need improved pre-service courses in science (as well as methods) designed for new elementary

teachers and more in-service experiences of the same design for those already teaching.

3. *Equipment in the elementary school that is adequate for carrying out the science curriculum.* Some of it can be made and pupils can learn when they make it; but some must be purchased and made available.

4. *A definite time in the schedule for science, just as we have for arithmetic and reading.* As long as we plan to do science in our spare time (how mythical can we be?), we will not have any time. As long as there is no time for science in the schedule, we will not have any science. As long as science is lumped with social studies, we will not have meaningful science experiences either.

5. *A 12-year sequence* (14-year if we consider junior college) *in the school science program.* This is necessary so that elementary and junior high schools and the other levels can build on previous experiences and provide ever-widening opportunities for children and young people. This means also that elementary teachers and junior and senior high school teachers—yes, and college science professors, too—must “get together,” learn to communicate with each other, and learn to work together.

6. *Supervisors and principals and administrators who are acquainted with the objectives of the science program.* They must know good science teaching when they see it, and they should intend actively to work to improve the science offerings.

These six attributes of an improved science program will surely have a great impact on the education of children who live in today's scientific world. Such a program will be for *all* children for they are all citizens. It will also encourage the specially talented for they will have the opportunity for satisfying experiences that will challenge them. It will also uncover potentialities and interests that might otherwise remain dormant. It will be the first and the foundation step on the road to a 12-year program in science that will produce scientifically informed citizens as well as scientists who will make the necessary contributions to the future of our country.

All of this does not mean that we ignore the other essential areas of the curriculum. It *does* mean, however, that we make science a *definite part* of the elementary school program. As long as we continue to ignore science, make it incidental, confine it to such things as the study of signs of autumn and how seeds are dispersed, we shall continue to have an inadequate beginning in this area that most thoughtful people believe is an essential part of a well-rounded educational program.

The Rationality of Some Intuitive Foundation Stones

This article is the address delivered by Dr. Snyder, current president of the American Association for the Advancement of Science, at the annual banquet, March 22, 1957, of the NSTA 5th National Convention in Cleveland, Ohio.

By LAURENCE H. SNYDER

Dean, Graduate School, University of Oklahoma, Norman

IN my graduate student days, when I was being painfully initiated into the complexities of the more advanced phases of various branches of science, I often found it soothing and rewarding to go back and read a very elementary text on the subject. Frequently this served to put my thoughts in order, and to strengthen the foundation upon which I was trying to build. Often, however, I found that some of the very foundation stones proved to be inadequately understood and explained, so that the superstructure I was building was sometimes based on some obscure and glossed-over concepts.

This situation, I think, is true not only of my own field of genetics, but of many areas of science: in spite of it there have been raised many solid edifices which have stood the test of time. It is comforting, however, to find now and then that a foundation stone that has been perceivable but not explainable has suddenly assumed rational rather than intuitive solidity. One's world thereby becomes a little more stable, and one's faith more justified.

Let us consider a few of the basic concepts of genetics which have recently emerged from the realm of semantic veneer into the world of rational solidity. Thus Mendel, in his famous paper, wrote (translated): "... those characters which are transmitted entire, or almost unchanged in the hybridization, and therefore in themselves constitute the characters of the hybrid, are termed the *dominant*, and those which become latent in the process *recessive*." In later years these terms have been applied

to the genes (Mendel's *elements*) themselves as well as to the characters.

We often find that in a particular cross, one gene of a pair is "dominant" to the other. But for many years this relationship was merely stated, not explained. Many students must have wondered, as I did, how one gene could dominate another. Today we have a simple, reasonable, biochemical explanation of dominance. We believe, on the basis of experimental data, that a gene functions by developing a specific substance, in most instances apparently an enzyme, which determines the effect of the gene on the individual. The enzyme produced is responsible for the catalysis of a particular step in the synthesis or degradation of some compound.

Thus the development of the basic pigment melanin in man is contingent upon the presence of a gene *C*. Its mutant allele *c* in homozygous state (*cc*) results in the well-known condition albinism. Normally-pigmented individuals may, however, be either *CC* or *Cc*. In other words, the presence of pigment is a dominant character, and *C* is said to be dominant to *c*.

Now melanin is elaborated by a series of biochemical steps from the amino acid tyrosine. (See accompanying figure.) Each step in this synthesis is catalyzed by an enzyme. One of these enzymes, tyrosinase, is always identifiable in pigmented individuals, who have the gene *C*, but is not demonstrable in albinos, who lack the gene *C*. Apparently the gene *C* is responsible for the elaboration of tyrosinase, while its mutant allele *c* fails to develop this enzyme. Equally apparently, one dose of gene *C* is as effective as two.

Enzymes as Catalytic Agents

Enzymes are organic catalytic agents which function by facilitating biochemical conversions all out of proportion to the amount of enzyme present; moreover, the enzyme is ordinarily not itself used up in the process. Consequently, when any particle of enzyme has accomplished its catalytic action, it dissociates itself from the resulting compound and is available for further catalytic activity. Thus a small amount of enzyme is generally sufficient to accomplish complete or nearly complete conversion.

It is easy to conceive, then, that one dose of gene *C* elaborates sufficient tyrosinase to convert the available tyrosine to melanin. Since two doses of gene *C* could do no more than this, the genotype *Cc* is as effective as the genotype *CC* in the development of pigment, and *C* is dominant to *c*.

As an analogy, consider your vitamin intake. If, as a child, each of your two parents provided you every day with your vitamin requirements, you

would have more vitamins than you really needed, but you would not suffer from vitamin deficiency diseases. If only one of your parents supplied the necessary vitamins, however, you would be equally healthy. Only if neither parent provided any vitamins would you show the effects of the deprivation.

This concept of dominance implies that a dominant gene results in the production of an active, effective substance, while a recessive gene fails to produce a substance which is similarly effective biochemically. The active substance may be an enzyme, an antigen, or an inhibitor. (Some biochemists believe that antigenic activity is in reality a specialized instance of enzymatic activity). It is quite conceivable that inhibitors also behave in an enzymatic way. At any rate, they are active and effective.

Genes As Inhibitors

It is not surprising, then, to find that genes which function as inhibitors (for example, color inhibitors) are often dominant, whereas those which fail to produce active substances are recessive. Thus, although true albinism is due to a recessive gene in both animals and plants, instances of dominant (i.e., inhibitor) white are known in many species.

It sometimes happens that a single dose of a given gene does not result in sufficient enzyme to carry out the reaction completely. In such cases dominance is lacking, and the heterozygote is distinguishable from both homozygotes. In some instances the heterozygote may be distinguished by the unaided senses; in others, special methods must be used.

One of Mendel's original experiments, with later developments concerning this example, will provide a case in point. When Mendel crossed true-breeding pea plants with round seeds (*RR*) to true-breeding plants with wrinkled seeds (*rr*), he obtained all round-seeded plants in the first hybrid generation. When these hybrid plants were self-pollinated, they produced plants with round seeds and plants with wrinkled seeds in the ratio 3:1. The gene for round is thus dominant to the gene for wrinkled. To the unaided eye the heterozygous *Rr* pea looks just as round and smooth as does the homozygous *RR*, in contrast to the wrinkled and shrunken seeds which are homozygous recessive *rr*. By microscopic examination of the food reserves of the two kinds of round seeds, however, a distinction is possible.

Immature pea seeds, whether destined to become round or wrinkled, contain sugar. In the homozygous *RR* seed, the sugar is almost entirely converted into starch as the seed matures. Since the starch retains water, the seed remains round, firm, and smooth. In the homozygous *rr* pea, however, very

little sugar is converted into starch, water is lost, and the seed coat wrinkles as the contents shrink.

In the heterozygous *Rr* peas the conversion proceeds far enough so that the seed remains smooth, but microscopic examination of the three types of seeds shows an abundance of well-formed starch grains in *RR* seeds, distinctly fewer and less perfect grains in *Rr* seeds, and very few indeed in *rr* seeds.

One Dose of the Gene *R*

Apparently one dose of the gene *R* does not produce quite enough enzyme to complete the conversion of sugar to starch, but two doses do produce enough. If one dose of *R* had resulted in the production of even less enzyme, the heterozygous seeds might even have been discernible to the naked eye, and dominance would have been completely lacking.

Not many examples of detectable heterozygotes have been thoroughly demonstrated in man, but a few instances are at least partially known. Let us consider briefly one of these, *afibrinogenemia*. Fibrinogen is one of the substances normally taking part in the blood clotting mechanism, being converted to fibrin by the thromboplastic activity of various enzymes, notably thrombin. Fibrinogen itself is formed from its precursor in the liver, and is a globulin with a molecular weight of about 350,000.

A rare hereditary human disease, frequently marked by fatal hemorrhage, is *afibrinogenemia*, in which the precursor is not converted to fibrinogen, presumably due to the fact that the implicated recessive gene does not produce the enzyme requisite for the conversion. Some researches indicate, however, that one dose of the dominant gene does not provide enough enzyme for complete conversion, so that in the heterozygotes a marked decrease in fibrinogen can be demonstrated, although the blood will still coagulate and the individual is clinically normal.

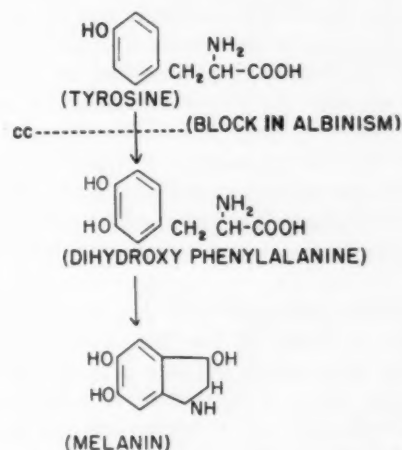
All-or-None?

Thus dominance is not an all-or-none phenomenon, but exists in varying degrees of completeness. It may be mentioned in passing that this fact makes feasible the purposeful search for various special methods for the detection of those persons who are heterozygous for recessive genes which, when in the homozygous state, may produce detrimental effects.

Another phenomenon, the understanding of which was long obscured by its being named but not explained, is epistasis. Epistasis is the masking of the effects of the genes of one pair by a gene of a different pair. It is, in short, a relationship between the genes of two separate pairs essentially similar to the

dominance relationship between the two alleles of one pair.

Many rational explanations of epistasis have come to light, and again they are often biochemical, and often remarkably simple. When, for example, two pigments are present, the darker one may simply obscure the lighter. Cotton, for instance, may



The metabolism of tyrosine to melanin and its failure in the presence of the genes *CC*.

have brown, green, or white lint. Two pairs of genes are concerned with the development of these colors. In one pair *B* results in brown pigment, *b* does not produce brown. In the other pair, *G* results in green coloration, *g* does not produce green. In the absence of both *B* and *G* (i.e., *bbgg*), the lint is white. When both *B* and *G* are present, *B* is epistatic to *G*, and the color is brown.

The F_2 ratio, therefore, is modified to 12 brown: 3 green: 1 white. Of the browns, some also have green and some do not. Although these two kinds cannot be differentiated on simple inspection, the hidden green in the former can readily be demonstrated by fluorescence in ultraviolet light. By applying this test, the standard ratio of 9:3:3:1 may readily be demonstrated.

Epistasis may also occur as a result of genetic heterogeneity. What appears at first glance to be a single clinical entity in man may sometimes, as a result of careful observation, be broken up into sub-entities, dependent on different genes. For some diseases, this situation may be recognized by the occurrence of one age-of-onset within certain families, another age-of-onset within other family groups. The infantile and juvenile forms of amaurotic idiocy are instances of this dual genetic basis for an abnormal condition. If both sets of genes were involved in a family, the recessive gene of each

pair would be expected to show epistasis over the dominant gene of the other pair. It is conjectured that each of the recessive genes involved in amaurotic idiocy is concerned with the lack of a specific enzyme in the sequential degradation of sphingomyelin in the cells of the nervous system.

Sometimes a clinical or age-of-onset differentiation is not obvious, but genetic heterogeneity is nevertheless apparent from family history data. The genetic instances of deaf-mutism appear to be the result of the homozygous condition of a recessive gene. Examples are known, however, in which a husband and wife, both genetically deaf-mute, have produced all hearing children. This situation indicates that two different recessive genes may each cause deaf-mutism. The expected F_2 ratio in such a cross would be the epistatic ratio of 9 hearing to 7 deaf.

A plausible explanation of this instance of epistasis is to be found in the fact that autopsies on the ears of deaf-mutes indicate that in some cases the auditory nerve is degenerate, in other cases the cochlea of the inner ear is degenerate. Either situation would result in deafness. An analogy would be the telephone, which could be made equally "deaf" either by cutting the cord leading to the receiver, or by jabbing an ice pick into the receiver itself.

Turning now to a more general problem, that of differentiation, it will be recalled that cells, tissues, and organs differentiate during development in what appears to be a paradoxical situation, namely, that mitosis results generally in an exact distribution of identical genes to daughter cells. How, then, if genes determine development, can cells of the body be strikingly different when they have identical complements of genes?

A State of Rational Solution

The problem is far from solved, but at least it is approaching a state of rational solution, and again the solution appears to lie in the area of biochemistry. There is evidence that some cells of an individual may occasionally deviate from the normal chromosomal complement, but this does not appear to be specifically correlated with tissue differentiation. Since the nuclei resulting from successive mitoses are, as far as can be experimentally determined, equivalent and interchangeable, it is to the cytoplasm that we must look for the mechanics of differentiation.

The cytoplasmic materials received by the two daughter cells following a mitosis need not be equivalent, and as a matter of fact, frequently are demonstrably different. Differentiated cells are chemically unlike, and both quantitative and quali-

tative differences in enzymatic activity have been demonstrated between various tissues of the same animal. Tissue-specific and organ-specific antigens are also found. Morphological and physiological differences follow the chemical differentiations.

The chemical divergences appear to be guided by genes, but it is a well-known aphorism of genetics that the action of a gene may be considerably altered by the environment, without the gene itself being changed in any way. The environment here is internal cytoplasmic arrangement, starting with the gradients in the egg itself, plus external forces of various sorts.

The Fertilized Egg

That there is in fact internal organization of the cytoplasm, even as early as the fertilized egg, has been amply demonstrated. Mitochondria, for example, are visible constituent particles of most cells. They contain certain enzyme systems, particularly the oxidative enzymes. One of the major factors involved in the occurrence of animal-vegetal polarity in eggs appears to be a mitochondrial gradient with its consequent enzyme gradient. Unequal distribution of mitochondria and other cytoplasmic inclusions at cell division would result in the placing of identical genes in different environments.

Not only have such enzyme gradients been demonstrated in the case of animal-vegetal polarity, but for dorso-ventrality and bilaterality in early developmental stages. In later development, the enzyme systems of various tissues are demonstrably different. Various types of cytoplasmic particles having different properties and functions occur, and the proportions of the various particles are characteristic for the kind of tissue.

In addition to unequal distribution of particles, other internal and external environments may influence the types and the relative numbers of cytoplasmic materials. The gradient field in which the cell occurs, the available concentrations of hydrogen ions, electrons, and substrates, all may influence the development of characteristic enzyme patterns. It must always be kept in mind, however, that differentiation—enzymatic, physiologic, and morphologic—takes place under the general guidance of genes. It would seem to be a reasonable inference that genes cannot exert an absolute control over the presence or absence of specific enzymes in the cell, but instead determine the potential development of particular enzymes and enzyme systems in particular environmental situations. Such actions of genes on the chemical level are quite in harmony with the long recognized observations on the gross phenotypic level.

TO TEACHERS OF SCIENCE:

A CHARGE AND A CHALLENGE

By Richard M. Sutton

Professor of Physics, Management Development Program, Case Institute of Technology, Cleveland, Ohio

I. KNOW YOUR STUFF.

Build sound knowledge of your subject.
Renew and extend it continually.
Reach beyond habitual and comfortable levels.

II. KEEP ALIVE.

Observe, experiment, and **THINK**: ask questions of Nature.
Read widely: keep asking questions of yourself.
Grow with your students and with the changing times.
Keep your spark of originality alive: cherish the spark of curiosity as you find it in your students.

III. BE INSPIRED—BE INSPIRING.

Give of yourself: teaching is a highly personal job.
Have a sense of mission: what you are doing has long-range importance.
Awaken in your students a desire to learn: you can only help them develop their own powers.
Make full use of your skills and personality: they are **YOU**.

It is a familiar observation in genetic studies that different genes produce their observable phenotypic effects at different times in the life history of an individual. The consequences of some genes in man, for example that conditioning gargoylism, are detectable in the embryo; of others, such as the gene for Huntington's chorea, only in later life. It is inevitable that the thoughtful student will speculate as to how some genes can exert their effects only after many years of the person's life have passed.

Here again the emerging facts and principles of biochemistry come to our rescue. Alternate metabolic pathways are the rule in biochemical reactions, and enzymes frequently compete for the same substrate. Moreover, equilibria become set up in many reversible reactions, and these equilibria may require considerable time to be reached. The establishment of an equilibrium may then free a substrate for a new conversion by a new enzyme. Certain by-products, slowly accumulating, may reach a critical level and act either as inhibitors or as new substrates.

It is becoming apparent, moreover, that biological proteins are mixed populations of molecules of very different ages. Some of the molecules are very new, others may be months or even years old. It is known that stored proteins, whether at body temperature or in the refrigerator, gradually change in their biological properties, and that these changes reflect changes in the conformation of the molecules. In other words, a living protein is undoubtedly composed of a population of molecules which differ in primary structure through age, site of formation, and various environmental causes such as temperature, antigens, toxins, and nutrition. The molecular changes may involve such chemical events as the formation of dithio bonds and the substitution of amino acids.

In this way a gene and its descendants may be located in a different environment in the mature individual from that in which they occurred in the embryo or the young organism. The effects of the genes could then be quite understandably different

(Continued on page 402)

EARTH



THE geophysicist who studies the earth itself faces a unique problem among scientists. He never has the opportunity of seeing all of his subject at one time (he doesn't even know its exact shape) and his subject is much too large to manipulate. The earth itself is his laboratory and the earth is always changing. It wobbles on its axis; its crust is constantly shifting; the very outlines of the continents change as shorelines are eaten away; and new islands are formed when volcanoes erupt beneath the sea. Many of the parameters he would like to measure, such as gravity, change from place to place on the earth and by far the greater portion of the earth's surface is hidden underneath oceans and icecaps.

Some of the things he studies happen quickly, earthquakes, for example, and he must always be on the alert for them. Other phenomena occur slowly over many years and their effects cannot

usually be studied directly. For example, some slow movements of the earth's crust have been detected only by the fact that underground pipelines became distorted through the years.

The geophysicist would like to know more about the core of the earth, but man's deepest borings do little more than scratch the crust. In this field he must get his knowledge by indirect observations such as measurements of the character and speed of propagation of earthquake waves.

Since he cannot yet stand back and take a look at the earth as a whole, the geophysicist is going to do the next best thing. During the 18-month International Geophysical Year, which began on July 1, 1957, geophysicists of all nations are making a concerted effort to observe and measure the earth in as many places as possible. These observations will fill in gaps and tie together work done in the past to give a more complete picture of this con-

Changing Laboratory

By MAURICE EWING

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stantly changing world than has ever been possible before.

During the IGY, intensive observations will be made in three fields relating to the earth's crust and interior. World-wide studies of seismology, which is concerned with earthquakes and lesser movements of the earth's crust, will be conducted with special emphasis on observations in remote regions not normally accessible to scientists. Measurements of gravity, the pull of the earth, will be made on all land masses and on most oceans. More accurate determinations of latitude and longitude will be made at selected points, using both conventional astronomical methods and a new photographic technique which in effect halts the moon in its movement across the night sky.

Through these studies we hope to come closer to finding the answers to some very fundamental questions about the shape of the earth and its structure. Among these questions are:

What is the precise shape of the earth? We know that the earth is not round but is flattened at the poles and bulges at the equator. We would like to know the exact dimensions of these irregularities.

How does the value of gravity vary over the surface of the earth? This information will give us clues to the composition and structure, as well as the shape, of the earth.

What causes earthquakes? Greater knowledge of the causal factors of earthquakes is of practical

use in anticipating (though not yet in forecasting) destructive earth shocks.

What is the internal constitution of the earth?

Are the continents drifting over the surface of the earth? This is an old theory which has never been proved or disproved.

How far apart are the continents? As yet we do not have this seemingly simple bit of information on which really accurate world-wide mapping depends.

Seismology

The important problems in seismology are the study of earthquakes and lesser earth tremors. Although man seems helpless in the face of cataclysmic events such as earthquakes, actually he can lessen the damage done by these disasters by studying their nature, by determining how likely they are to occur in specific locations, and by mapping the geographic extent of their effects.

Although the more or less systematic observation of earthquake effects has been going on for hundreds of years, seismology was strictly a descriptive science until the development of the first station-type seismography in the late 19th century.

Basically the seismograph consists of a heavy mass mounted so that a vibration of its support, together with the inertia of the mass, causes a relative motion of the mass and its support. By a system of electrical and optical linkages, modern seismographs use this relative movement to pro-

duce a photographic record of the earth's vibration on film. Because different materials in the earth's crust and core bend seismic waves in different ways and transmit them at different speeds, analysis of these seismograph records can divulge information about the composition and structure of the earth.

Seismologists use two major research methods: artificial tremors from manmade explosions and a constant watch for natural tremors. Both methods will be employed during the International Geophysical Year. For the IGY program the dynamite charges used to produce artificial tremors will be larger than in any study heretofore. The standardized instrumentation at the new IGY stations will eliminate variables which complicate the interpretation of data observed at many existing stations. Research in seismology at IGY stations is directed primarily toward the study of elastic wave propagation and its interpretation in terms of earth structure.

Seismological studies have long been conducted on an internationally cooperative basis, and there is now a network of about 300 standard seismograph "listening" stations over the world. Of these, 20 are new stations installed during the IGY, and others may be added. The new stations will contribute much needed information for detailed study of earthquakes in vast, remote areas such as the Pacific Ocean, Antarctica, and the Arctic Basin, where virtually no measurements of this kind have been made in the past.

Nine of the new stations have been installed by the U.S. National IGY Committee—three on the equatorial Pacific islands of Guam, Truk, and Palau; two in the Arctic at Point Barrow, Alaska and Thule, Greenland; and four at USNC-IGY sta-

tions in Antarctica. The Scripps Institution of Oceanography will also install a seismograph on Palmyra Island, in the central Pacific, as an adjunct to its oceanographic program. In all, a total of 47 nations are participating in the IGY world-wide seismology program.

In the Antarctic, portable seismographs are being used to complement and supplement the station type seismographs. These portable instruments have already been put to use on the 600-mile traverses over the frigid icecap between Little America and Byrd Station. Surveys of the ice thickness along the route were made at regular intervals using the reflection technique in which charges of dynamite are exploded in shallow holes and the transit time of sound waves travelling through the ice to the ground and back to the instrument is measured to a hundredth of a second. This technique gives a profile of the continental terrain as well as the thickness of the overlying ice. Near Byrd Station preliminary seismic soundings indicate that the ice cover of the continent may be 10,000 feet thick at a point where the ice surface is only 5000 feet above sea level!

To supplement further the world seismographic network, the California Institute of Technology is constructing two strain seismometers in the Andes mountains of South America which are designed to measure directly the accumulation of stresses in the earth's crust which trigger active earthquakes.

The importance of better information in this field was dramatically emphasized early in 1957 when a sudden earth movement along the San Andreas Fault seriously shook San Francisco and caused considerable damage. Back in 1940 a slight crustal movement along this fault shifted a portion of the United States-Mexico border by ten feet. And in 1906 the same fault produced the great San Francisco earthquake which killed hundreds of persons and caused property damage of \$400 million.

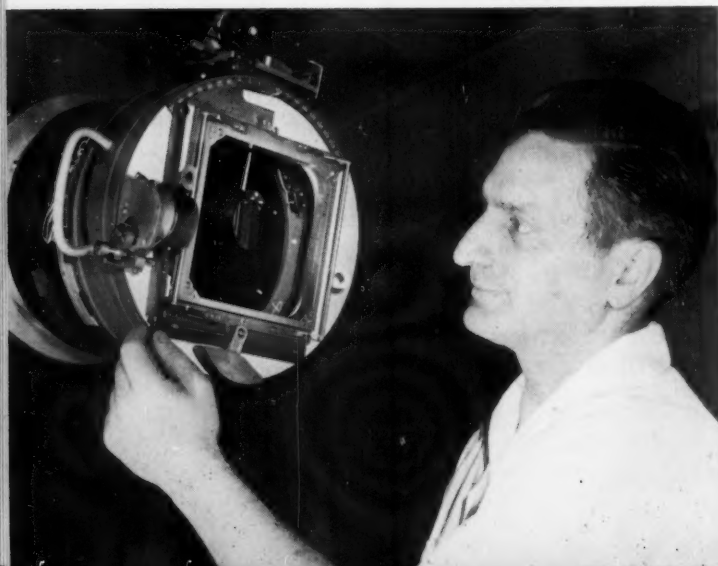
Figure 1 shows the seismic zones of the earth where earthquakes are most likely to occur. The observations being made during the IGY will provide data from which more accurate maps of earthquake areas can be drawn.

Gravity

The great aim of the IGY gravity program is to establish a reliable gravity map for the entire earth. A gap in the international network of gravity observations extends over most of the Southern Hemisphere and the Arctic. Also, though gravity measurements are made by many nations, there is no

Dr. William Markowitz with the Markowitz dual-rate moon-position camera, used in the IGY latitude and longitude program.

OFFICIAL U. S. NAVY PHOTOGRAPH



The SCIENCE TEACHER

universally accepted gravity standard because different instruments have been used to make the measurements. IGY scientists plan to extend the world gravity network to remote areas, to resolve differences in reported values in areas already measured, and to work toward the establishment of a world-wide gravity standard. Twenty four nations will make gravity observations during the IGY.

United States scientists will make gravity measurements in the Western Hemisphere, the Arctic, the Antarctic, and the Atlantic and Pacific Oceans. Pendulum measurements, which give absolute values, will be used at key stations to help establish a common gravity standard throughout the world. Gravimeters, which measure relative gravity, will be used to interpolate between the key stations. Gravimeters are similar in principle to the old-fashioned spring balance but are incomparably more accurate. For example, the gravimeters used to measure earth tides are so sensitive that they respond to the change in gravity which would result from a vertical movement of about one eightieth of an inch.

Portable gravimeters are already in use on the antarctic glaciology traverses. A team of two men went to the Antarctic in the winter of 1956-57 to make pendulum and gravimeter measurements at some of the antarctic stations. Their results will be used as reference values for the traverse teams, and also to establish ties to measurements made in lands of the Southern Hemisphere. In travelling to the Antarctic, the team made measurements at sites in South America, Japan, the Philippines, Australia, and New Zealand.

In the Arctic, pendulum ties have been made to the two IGY drifting stations in the Arctic Ocean, Fletcher's Ice Island and Station A, which is on a large ice floe. Scientists on Station A have discovered a previously unknown submarine ridge 5000



Worden gravimeter in use at Little America.

feet high through gravity observations combined with depth soundings.

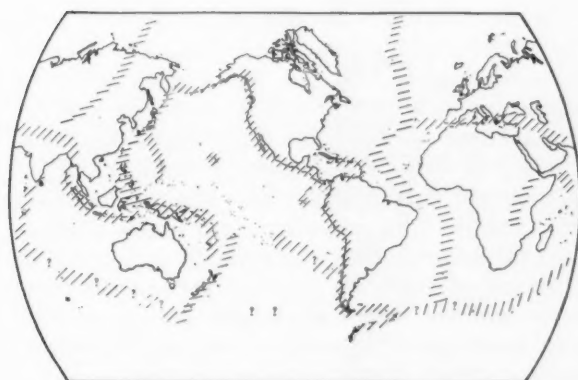
The vast oceanic areas of the world have long been a barrier to the establishment of a true world-wide net of gravity measurements. The problem of measuring gravity on ships at sea is complicated by the motion of the sea and the motion of the vessel itself. However, by using submarines which can descend below these surface disturbances, gravity measurements can be obtained, with the pendulum apparatus invented by F. A. Vening Meinesz, in the vast ocean areas which cover about 75 per cent of the globe. New gravimeters designed by Professor Anton Graf of Munich may even be adaptable for use in surface vessels. If so, the blank spaces representing the oceans on the world's gravity map can be filled in much more rapidly than anticipated.

Successful completion of the IGY observational program will provide scientists and engineers of all nations with fundamental gravity data which will be used in studies of the precise shape of the earth, in preparation of new and more accurate world maps, in structural geology investigations, in prospecting for oil and minerals, and in many other fields of geophysics.

Latitude and Longitude

Most people believe that the position of the earth's latitudes and longitudes and the location of geographical features are known precisely. For many practical problems this is true: Cartographers can make reasonably precise maps, and navigators can use these maps in guiding their ships or aircraft. But during World War II, certain of the Pacific Islands were found to be as much as a mile from their presumed locations. Even today we do not know exactly how far apart the continents are. During the IGY, very precise measurements of lati-

FIGURE 1. Seismic zones.



tude and longitude are being made at 20 locations around the world.

Actually, latitude and longitude studies during the IGY consist of two distinct programs with different objectives. The astronomical longitude and latitude program provides coordinates of the observing stations with reference to celestial bodies, while the moon position program provides coordinates with reference to the center of the earth.

Since astronomical coordinates are measured with reference to the vertical, they are affected by gravity anomalies. Despite this, the coordinates may be determined with great precision. Probable errors in the positions determined in the IGY program will be about five feet. This accuracy is possible because of the high precision of the observing instrument used, an "impersonal" astrolabe developed by A. Danjon of the Paris Observatory. This instrument is called impersonal because it is designed to minimize the observational error of the human operator.

The astrolabe makes use of a basin of mercury to indicate the apparent vertical and an optical system which presents two images of the star under observation in the eyepiece. To make an observation, the observer manipulates a prism so as to keep the two images parallel to an illuminated thread. The position of the prism indicating the altitude of the star is recorded on a chronograph, which indicates the instant of the desired observation, thus eliminating the need for the observer to mark and time an observation.

The IGY moon position program will provide information on the size and shape of the earth independent of gravity and will improve our knowledge of the orbit of the moon.

The program depends on observations made with the "dual-rate moon-position camera," developed by William Markowitz of the U.S. Naval Observatory. By use of a very ingenious mechanism, this camera photographs at one time both the moon and the stars, though they move at different rates, and

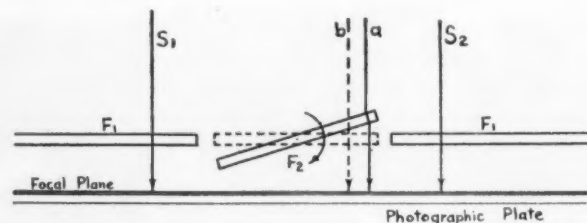


FIGURE 2. A ray of the moon's image, at a , is deviated as it passes through the tilted filter, F_2 . When the filters are parallel there is no deviation, as at b . A continuous tilting of the filter during the exposure removes the motion of the moon relative to the stars, at S_1 and S_2 .



DANIEL LINEHAN, S.J., WESTON OBSERVATORY, MASS.

Explosion for seismic sounding in stranded moraine (glacial debris) in the southern section of McMurdo Sound, Antarctica.

holds the moon's image fixed relative to the stars.

In the dual-rate camera, the plate carriage is driven at the same rate as the apparent movement of the stars. Therefore the images of the stars fall at the same positions on the photographic plate throughout the exposure. At the center of the field of the camera is a dark plane-parallel glass filter which reduces the intensity of the moon's image by a factor of 1000. During the exposure, the filter is tilted, thereby moving the image of the moon (see Figure 2). The axis of tilt and the rate of tilt are selected for each observation so as to hold the moon fixed relative to the stars. The time of observation is the instant when the dark filter is parallel to the light yellow filter which is in front of the star field.

The distances between the center of the moon and the fixed stars are measured on the plate by a measuring engine of extremely high accuracy. These measurements give information on the position of the moon relative to the stars with a precision higher than that obtained by other methods.

In theory the three coordinates of the observer with respect to the center of the earth (distance, latitude, and longitude) can be determined with two observations of the moon. In practice about 200 observations will be made at each station, giving positions of the stations with probable errors of about 100 to 200 feet. The results from all the 20 stations will be combined to determine the size and shape of the earth. This determination will differ from all others in that it is based solely on geometry and is independent of gravity.

In order to apply this method the distance from the earth to the moon must be known. The distance from Washington, D.C. to San Diego, California has been measured, and will be used as a base for triangulation measurements to determine this value.

The IGY latitude and longitude program will not only provide data of immediate value to science but will establish base values to which future observations can be compared. For example, comparison of astronomical positions obtained perhaps 50 years hence with the values determined during the IGY may settle the old question of whether the continents are fixed in position or are drifting.



LOOKING BACKWARD ON FUTURE SCIENTISTS

By **SAMUEL STRAUSS**

McKinley High School, Washington, D. C.

MANY SUCCESSFUL PEOPLE look back upon their teachers with affection and respect, gratefully remembering the personal interest and the encouragement that they received. Such attention was an important factor in their efforts to reach positions of leadership in their chosen work, as they will tell any listener.

On the other hand, there are many able persons who received no encouragement, who can recall no teacher who took any personal interest in them. Some of these people went on to success without such support, driven by other powerful forces in their lives. How many potentially successful youths gave up, feeling that they had no chance, that they were not worthy, that the world was not their oyster, will never be known.

Certain it is, that many junior and senior high school pupils have been told by their teachers and counselors that they should not take mathematics or science courses, that they should not attempt college preparatory work, nor plan for a future academic career. Such advice is frequently based upon an examination of the IQ test scores and the scholastic marks shown on the students' records.

A Study Is Made

During the academic year 1955-56 the writer, awarded a Ford Foundation teacher fellowship, studied the lives of 89 men who earned the Ph.D. degree in physics, chemistry, and engineering at The Ohio State University, the University of California (Berkeley), and Cornell University. One part of the project was to visit the high schools from which the men had been graduated, where their school records could be studied. Faculty members who re-

membered the men when they had been high school students were interviewed.

The high school records included IQ scores, as determined by a variety of standardized tests. According to the test scores, the IQ's of the 89 physical scientists ranged as follows:

From 96 through 100	3 %
From 101 through 110	6 %
From 111 through 120	29 %
From 121 through 130	36 %
From 131 through 140	17 %
From 141 through 165	9 %

This tabulation contrasts with the IQ score of 120 that is generally regarded as the minimum essential for the successful completion of college work, to say nothing of graduate school. As can be seen, 38 per cent of these men would not have qualified under such a standard. It may be that the IQ scores shown on the records were not accurate, but, regardless, these very scores no doubt served as their teachers' criteria of the mental ability of the boys and as a basis for counseling.

In a similar study of 30 biological and 30 social scientists previously made by the writer, the men were asked, "How much intelligence does a scientist need to have?" They replied:

Of a high order	22 %
Above average	33 %
About average	40 %
Even below average	5 %

These figures indicate that working scientists consider that average or somewhat above average intelligence is sufficient for scientific research. More than 80 per cent of the scientists interviewed expressed the opinion that other factors were as important as or more important than intelligence for doing scientific research. The factors they named, in the order of frequency of mention, were: perseverance, interest, training (education), interest in people, the ability to see relationships, hard work, curiosity, intellectual honesty, rigorousness, open-mindedness, imagination, personality, skill in writing and speaking, and a good memory.

Scholarship and Solitude

The emphasis placed on interest in people and on personality is due to a special fact. It is that the days when scientists labored in solitude are now generally gone; complex problems are investigated by scientists working in groups, where the ability to get along with others is of considerable importance.

The high school records also showed the marks earned by the scientists and their ranks in the grad-

uating class when they were students. It is probably the general attitude that any future scholar is earmarked by outstanding work in high school; many scholarships and prizes are awarded on the basis of very high standing in class.

Examination of the high school records of the 89 physical scientists under study revealed their ranks in their high school graduating classes as follows:

In top 1 % of class	10 %
In top 2 % of class	22 %
In top 5 % of class	43 %
In top 10 % of class	64 %
In top 15 % of class	79 %
In top 25 % of class	92 %
In top 33 % of class	97 %
In top 50 % of class	100 %

It can be seen that not all of these boys had shown the brilliant scholarship that is supposed to be the sign of the future scientist. The boys had all been in the top half of their classes, but 36 per cent had been below the top tenth. They had been good, but not always the exceptional students in high school. It was also noted that a conspicuous prevailing element in the high school program of these boys was the inclusion of all the courses in mathematics that they could take, although they did not always earn high marks in their mathematics classes.

The Mark of the Future Scientist

The foregoing data are in agreement with the information gathered in the former study that was previously mentioned. Of 60 biological and social scientists who had earned the Ph.D. degree, 43 per cent said that they had ranked in the top tenth of their high school graduating classes; another 43 per cent said that they had ranked in the top third, but not in the top tenth, of their classes; and 14 per cent of the men said that they had been about in the middle of their high school classes at graduation.

The scientists expressed their appreciation of the value of their high school training. They said that the chief contribution was the good background for college work they had received. They also gave the high schools considerable credit for stimulating and establishing their scientific interests. A few men said that they had developed good work habits while in high school.

If it is not superior intelligence or the highest scholarship that marks the future scientist, what other signs will help to identify promising youths and assist them to future success?

After quite intensive and careful study of the lives of 169 scientists, the writer ventures to make some generalizations. The first is that the scientists

studied did not show any discernible and characteristic peculiarities. They engaged to a considerable degree in high school and collegiate extracurricular activities, they were much influenced by other people, and they came from families at all social and economic levels. They now enjoy social contacts, engage in many and varied forms of recreation, are happy in their chosen life work, frequently take part in community and church activities, and make excellent husbands and family men. In general, they seem to be what may be regarded as normal persons.

What made the men become scientists? The dominant force that shaped their lives seems to have been *drive*. By drive is meant the urge that made them improve their scholarship while in college and do even better in graduate school; that made them work hard for many years on their graduate program, often under the most difficult conditions, and to persevere in spite of the many hurdles and obstacles in their paths. The drive in a surprisingly large number of cases seems to have been due to frustrations that generally occurred early in their lives, such as the failure to be accepted as an equal by the peer group, or by family pressures and tensions, or by minority status; or by some combination of these three and other minor factors. The drive, actuated by an unconscious desire "to show them," was probably established by the time the boys reached their early teens. The pursuit of the highest-earned academic degree as the "union card" for the training to do scientific research, served to provide a satisfying outlet for the drive.

Another factor is the apparent presence of a degree of nonconformity among scientists. This showed up early in life and was frequently reported by the high school teachers visited. The boys did not always do what was expected of them, though they were seldom anti-social. For example, there was the boy who became so interested during a mathematics examination in alternative methods of solving the first problem that he never did complete the rest of the test. There was another boy who knew so much about chemistry, as a result of his work with a brother at home, that he was bored by the class work and never bothered to hand in his papers. The teachers of these boys reported that they had realized that the boys had ability, but they could not give them high marks. In neither case, nor in many others, did the boys care whether they received a high or a low mark.

A highly important factor was the effect upon the future scientists of the personal interest taken in them by others. The faith and the interest expressed in the boys by some elementary or high school teacher or by a college instructor, made a

deep impression and constituted a dominant force in the lives of the men studied. It was noticeable that the men who had attended very large high schools seldom reported that they had been influenced by a teacher in that institution and, when visited, the teachers in those schools rarely even remembered the former students. But in smaller schools, the influence of the teachers was felt strongly and clearly and, when visited, the teachers knew all about the boys. It was not alone the encouragement of science teachers that affected the boys; various scientists reported that they had been influenced by mathematics, English, history, typing, language, and shop teachers; by coaches, principals, and superintendents; by part-time and vacation employers; and by parents and other relatives. It may fairly be said that the personal interest and the encouragement advanced by any adult to an impressionable boy or girl looking for a satisfying outlet for his inner drive may set him or her on the road toward a scientific career.

The tentative findings of the studies discussed indicate that while students in the lower half of high school classes may not develop into scientists, some of those in the lower reaches of the higher half do. Care must be exercised not to overlook potential scholars by over-dependence upon such standard criteria as IQ's and school marks.

Teachers should practice democracy in the classroom. They should devote at least as much time and energy to the promising intellectual leaders as to those pupils who, at the very best, can never be more than mediocre. Teachers should devote themselves toward the channeling of the inner drives of our able youths into worthy social ends. Their work will then be so much more rewarding, and our nation will benefit greatly by obtaining the desperately needed trained minds.

OUR FUTURE

GOES TO SCHOOL TODAY

This is the 1958 theme for the National Education Association as selected by NEA President Lyman V. Ginger. It will be the theme of the NEA annual convention in Cleveland, Ohio next June and also the topic of Dr. Ginger's presidential address at that meeting. In announcing the theme, Dr. Ginger said: "What we teach and how well we teach our students today will have a vital effect on our tomorrows. . . . Where Russia is today with sputniks and its streamlined science program is a result of philosophies put to work 15 or more years ago."

NEW

VOLSTAS

HOW many high school students would be more interested in science careers if they could really do something creative and challenging? How many high school students could be stimulated by doing scientific research in high school?

How many science teachers thought they would be able to conduct research while they were teaching in high school? How many science teachers are leaving the profession because they are unable to do research?

These are desires that are difficult to fulfill. However, there has emerged a way in which these questions can be answered positively and, at the same time, encourage research-minded science teachers to remain in education.

In the summer of 1956, I was fortunate to attend a National Science Foundation Institute for science teachers at American University in Washington, D.C. Part of the program involved spending every afternoon at the National Institutes of Health at Bethesda, Maryland. The purpose of the program was to place science teachers in close contact with scientists and scientific investigation.

The work proved to be so interesting and the project I selected to work on, so challenging, that the six weeks were soon gone. It seemed a pity to just stop the work. Why couldn't it be continued? Why, indeed! Why couldn't high school youth work as assistants on such a project? Where would the equipment be obtained?

Consultation with the scientists in the group resulted in the suggestion that the Board of Grants of the National Institutes of Health be contacted. The

funds that were available, it developed, had always been awarded to colleges and universities, but checking the rules regulating the awards also revealed that no stipulation was made that they could not go to a high school. It was suggested that an application be submitted.

The application made was titled, "Basic Research on the High School Level." The project had two aims:

1. To help stimulate interest by using high school students as assistants in conducting basic research.
2. To ascertain the number and identity of the free amino acids in a series of fruits and to note how they are affected when consumed by the body.

The grant was approved. A sum of \$2300 was provided to conduct the research project. This was the first such grant awarded to a high school in the United States.

The funds were provided to purchase equipment,

On-the-job research is a new frontier for high school science teachers. This article reports on work carried out under the first grant made for this purpose by the National Institutes of Health. NSTA is also pioneering in this field through its Future Scientists of America Foundation. A report on the first FSAF grants and the procedure for applying is included in *FSA Activities* on page 408 of this issue of *TST*.

in Science Research

By ROBERT SILBER

Chemistry Teacher, Central High School, Evansville, Indiana

books, chemicals, glassware, etc. Enough was also provided to pay the director of the research and assistants. Some funds for travel to obtain information or consultation were also included.

With the grant received, the work started. Students were asked to make application to work as research assistants. These applicants were interviewed and five selected as a good nucleus. These were selected on the basis of their interests, academic marks, and science subjects taken.

Equipment was ordered; the handling of finances through the business office cleared; the building cleared for use; and many other details which had to be cleared, since this was an entirely new project.

Work on the project was done immediately after school from 3:30 to 6:00 p.m., two days per week. The first sessions (while waiting for equipment) were devoted to orientation. When the equipment arrived and actual work began, each student was shown the whole process of extracting the amino acid concentrate from the fruit, running it through ion-exchange columns, lyophilizing it, and finally separating the amino acids by paper chromatography. The students were then able to carry out the whole process without help. Their only shortcoming was in interpreting the results and they were learning this.

As a result of all of this, the students showed a marked improvement in their laboratory ability, a greater understanding and appreciation of research, and a closeness to science which they had never before experienced. It cannot be said definitely but some implications can be drawn as to how they were

influenced by such training through checking their career selections upon entering college. Of the five students, one now plans to be an engineer, another a medical doctor, two plan to be chemists, and the fifth a medical technologist.

The research progressed nicely, but in the time from February until June, much was left undone. The research is still being continued and greater results are expected. Another application is now pending, to continue the research.

The whole program is a very worth-while one. It offers activity whereby students can actually experience scientific research and it enables teachers desiring research experiences to conduct their own research. Two contributions are thus made.

Work in the laboratory became a fascinating activity for the student research assistants and it stimulated their interest in science careers.



**on
behalf
of**

ARCHIMEDES

By J. STANLEY MARSHALL

State University Teachers College, Cortland, New York

Drawings by F. S. Carson



IN THE CHANGEOVER to modern physics in which added emphasis is given to such areas as electronics and nuclear power, some of the standard topics are being deleted from the course or are being placed in the optional category. This is particularly true in the high schools. While it is true that high school physics stands in need of revision and streamlining, we should move cautiously in casting aside the study of basic science concepts.

Archimedes' principle has felt the ax in some schools. There are two sides to every question and those teachers who have deleted this topic from their course may have justification. But there exists the possibility that Archimedes' principle is just "too hard to get across" and consumes "too much time."

These troubles could be at least partly remedied by changing somewhat the approach used in most textbooks and in many classes.

The real reason why bodies are buoyed up when they are immersed in fluids is far simpler than it appears in most physics textbooks. The text generally starts out with the formal statement that "any

body placed in water is buoyed up by a force equal to the weight of the water displaced." This statement is expanded, explained, illustrated, and demonstrated. The class may go to the laboratory in search of experimental evidence. All very well. But the real, physical reason for the truth of the statement lies in a study of the forces acting on the body. For proof of this, let us consider a cubical block of steel, suspended by a rope, one foot below the surface in a tank filled with fresh water. The block measures one foot on each side and thus has a volume of one cubic foot. See Figure 1.

Since steel is about eight times heavier than water, we know that the weight of this block is about eight times the weight of one cubic foot of water, which is 62.5 pounds. And so the downward force due to the block's weight is 500 pounds. But what of the aforementioned forces acting on the body—forces other than the body's own weight?

It becomes immediately apparent that the submerged block has six faces. Four of these are vertical and are acted upon by the forces of the water against

them. But these forces can be viewed as occurring in pairs. In Figure 1, side A and side B, which is just opposite A on the other side of the block, are being pushed in opposite directions by the force of the water. Since these forces must be equal, we can assume that they cancel each other out. Side C and its opposite number, D, do likewise for the same reason. This leaves only the top and bottom surfaces to be accounted for in our analysis of forces.

As every beginning physics student shortly learns, the water pressure exerted on any surface depends upon the height to which water is piled up above that surface. There is one foot of water above the top surface of the block. Fresh water exerts a pressure of 62.5 pounds per square foot at a depth of one foot; thus the force acting on the top surface of the block, which has an area of one square foot, measures 62.5 pounds. Remember that this is a downward force, due to the water's weight.

Now let us consider the force acting on the bottom surface of the block. This face of the block also has an area of one square foot; it is, however, two feet below the surface of the water. As we keep in mind that water pressure at any point is exerted equally in all directions, it can easily be determined that the upward force on the bottom of the block is two times 62.5 or 125 pounds.

Now we have discovered that the downward force on the top of the block is 62.5 pounds and that the upward force on the bottom is 125 pounds. The difference between these two opposing forces is 62.5 pounds, and it is an upward force. But notice that *this value is exactly the same as the weight of the cubic foot of water that the block displaces*. Alas, this is no coincidence! It is proof that the statement "a body is buoyed up by a force equal to the weight of water displaced" really means that the body is

The November issue of *The Science Teacher* featured a comprehensive report on The Physical Science Study, which is trail blazing in its field. This article by Dr. Marshall, submitted for publication about the time the November issue was going to press, presents the case for Archimedes. The editors of *TST* will welcome opinions on the "controversy"—if it is one.

pushed upward by the amount that the upward force on the bottom is greater than the downward force on the top. A physical and mathematical analysis of the forces acting on bodies of irregular shape would not be quite so simple but the relationship presented here applies to all bodies.

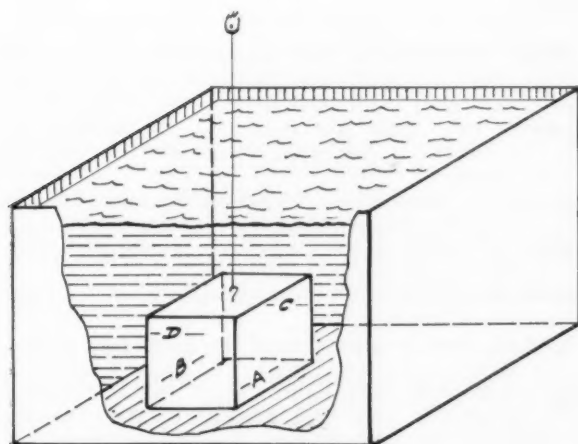
However, the concept of displacement has meaning and no suggestion is made here that it be discarded. It is true that when a body is submerged, it must "push out of the way" a volume of water equal to the volume of that part of the body that goes under. If, as in the case of the steel block, the volume of water pushed aside is one cubic foot, and this cubic foot of water weighs 62.5 pounds, then the force with which the displaced water pushes back on the block is 62.5 pounds.

The case of a wood block which floats may better illustrate this point. If a cubical wood block with a volume of one cubic foot floats half submerged, it must be displacing one-half cubic foot of water. If one asks, "How hard to you have to push downward to submerge this block completely?" the answer must be, "Hard enough to push aside the other one-half cubic foot of water—31.25 pounds."

The author has used a simple device to demonstrate this principle and one or two others closely related. It consists of a small floating vessel with a cargo space. A block of soft wood—pine, for example—measuring about two inches by $1\frac{1}{2}$ inches by one inch is used as the vessel. A wood chisel is used to cut a "hold," or cargo space, out of the block's center. Then the block is treated to prevent its soaking up water. Shellac, paint, linseed oil, or other materials may be used. See Figure 2. This vessel is used as a teaching aid in the following manner.

An overflow can has water added until a few drops flow out of the spout. Now the vessel is carefully lowered into the water. As it settles to its normal floating position, some water is displaced—water equal in volume to the volume of the vessel that is under water. This fact is immediately apparent to the observer by simple logic. Now the demonstrator drops some lead shot into the cargo

Figure 1



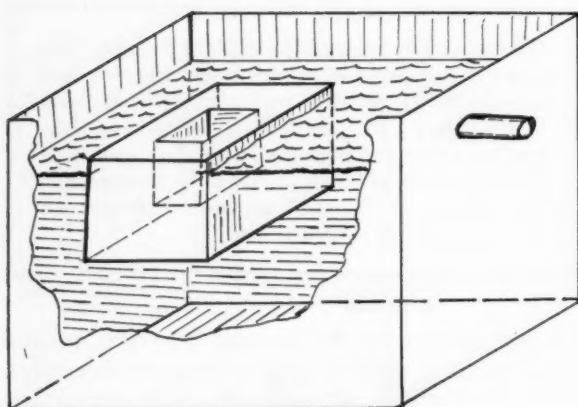


Figure 2

space; this causes the vessel to settle deeper in the water and more water runs out of the overflow can. The student should be asked to think through and verbalize the relationship between the weight, or downward force, and the water displaced, or upward force.

More shot is added and the vessel is seen to settle deeper—and, of course, more water runs out of the overflow spout. If the demonstrator continues to add shot, the vessel will soon reach a point where it “floats entirely submerged,” that is, the top of the vessel is just level with the surface of the water.

Here is a good time for a dramatic pause in the demonstration. The teacher would do well to draw from the students the idea that “the vessel is displacing all it can—there’s nothing we can do now to make more water run out of the spout.” And since the upward force is dependent on (and numerically the same as) the weight of water displaced, then we have also reached the point where the upward force cannot be increased. And so the teacher might summarize the demonstration so far by pointing out that the vessel floats because the downward force due to its weight is just equal to the upward force which is equal to its displacement. But now the upward force, or displacement, cannot be increased. What next?

If an alert student has not already suggested it, the teacher should ask what will happen if a few more shot are added to the vessel. The addition of more weight adds to the downward force, of course. But the class has already observed that there is no possible way to increase the displacement. After the additional shot have been added and the downward force exceeds the upward force, the vessel starts to move downward. As soon as the vessel goes under, water fills the vacant part of the cargo space and adds still more to the downward force.

With the vessel resting on the bottom of the can,

some other aspects of buoyancy can be investigated. Can the vessel be made to remain suspended at a point between the bottom and the surface of the water? The experimenter can use forceps or a spoon to remove shot from the vessel one at a time until it is lightened enough to rise. (Why is it necessary to remove more shot now than were added in the last step to make the vessel sink?)

Archimedes’ principle fits in very well with two other topics in basic physics—density and specific gravity. If the student is to acquire an understanding of these basic concepts, then why not also give him the opportunity to gain some understanding of buoyant forces. To do less is to leave him perched on a two-legged stool.

Nor is the usefulness of a knowledge of Archimedes’ principle a thing of the past. Boys are still building boats; diving is an increasingly popular sport; swimming rafts are being constructed each summer; and great ships still sail the seas. Long live Archimedes!



As a regular feature of *The Science Teacher*, the calendar will list meetings or events of interest to science teachers which are national or regional in scope. Send your dates to *TST*’s calendar editor. Space limitations prevent listings of state and local meetings.

- January 30-February 1, 1958:** Annual Meeting, American Association of Physics Teachers in joint session with the American Physical Society, New York City
- February 20-22, 1958:** Annual Meeting, the National Association for Research in Science Teaching, Chicago, Illinois
- February 22, 1958:** National Council for Elementary Science, Chicago, Illinois
- March 2-3, 1958:** National Council for Elementary Science, Seattle, Washington
- March 26-29, 1958:** NSTA Sixth National Convention, Denver, Colorado
- April 12, 1958:** National Council for Elementary Science, Atlantic City, New Jersey
- April 24-25, 1958:** 1958 Eastern States Health Education Conference, New York Academy of Medicine, New York City



RATS, MILK and CHOCOLATE

By MARY L. LAW and KATHERINE D. BENTLEY

Department of Physiology, Division of Basic Health Sciences, Emory University, Georgia

IN the schools of today instead of accepting scientific facts and knowledge verbatim from textbooks, students are doing classroom experiments in which they observe the results of experiments demonstrating scientific principles. Since nutrition is a subject that is discussed widely and confronts the reader often in the newspapers and magazines, many teachers design nutritional experiments in which rats or hamsters are used.

Unfortunately, sometimes these experiments are not properly designed to illustrate sound scientific principles. For example, one animal is fed an adequate diet with milk added and the other is restricted to candy and cake with water to drink. In the course of time the animal that is fed only candy and cake dies of malnutrition. The results of this type of so-called experiment in nutrition may be and quite often are interpreted to mean that candy and cake are actually harmful when eaten by the rat or child.

It is true that one reads in various publications that there is widespread malnutrition in the children and adults of our country and that this malnutrition is brought about by the ingestion of "excessive"

amounts of refined carbohydrates. However, recent surveys show that the children of today are taller and heavier than their parents.

It is, of course, possible for one to eat such a large quantity of refined carbohydrate that there is not room in the diet for the protective foods which contain proteins, minerals, and vitamins. In the report of the Food and Nutrition Board, National Research Council, on "Recommended Dietary Allowances," less than one half the total caloric requirements are listed. Thus more than 50 per cent of the total calories may be selected from any form of food stuff without upsetting the normal diet.

Since it is a certainty that the American public enjoys sweets and sweetened beverages and since these items will always be a part of our diet, it was thought that a study should be conducted to investigate the effects of the addition of a rather large amount of refined carbohydrate in the form of candy and soft beverage to the diet of rats that have access to an adequate diet. For a further comparison it was thought that a study of the effect of the addition of a relatively large quantity of milk to an adequate diet was also worthy of investigation.

Experimental data on rats fed a stock diet (Group A) and litter mates fed the same diet to which milk (Group B) or chocolate and a sweetened beverage (Group C) were added as a supplement *

	MALES			FEMALES		
	Group A	Group B	Group C	Group A	Group B	Group C
Total caloric intake.....	8810	9730	9580	7950	7930	7790
Body weight (gm).....	273	314	312	206	210	200
Body length (cm).....	23	24	24	21	21	21
Organs (% of body weight)						
Liver.....	3.11	3.21	3.21	3.44	3.57	3.35
Kidneys.....	0.73	0.70	0.71	0.73	0.71	0.75
Heart.....	0.33	0.31	0.32	0.36	0.37	0.36
Spleen.....	0.22	0.20	0.21	0.28	0.28	0.28
Femurs						
Dry weight (gm).....	0.46	0.49	0.50	0.37	0.39	0.36
Length (cm).....	3.4	3.5	3.5	3.1	3.2	3.1
Diameter (mm).....	2.8	2.9	2.9	2.6	2.7	2.6
Chemical analysis						
% Ca.....	24.7	24.8	25.0	25.0	24.6	25.0
% P.....	11.5	11.5	11.6	11.5	11.5	11.6
Ca/P.....	2.1	2.1	2.1	2.1	2.1	2.1
Teeth						
Caries score.....	8	8	8	8	8	8

* Each value in the table is an average on 15 animals.

Ninety weanling albino rats were selected in litter mate groups of three of the same sex. All the animals were fed a stock diet ** *ad libitum* which has been found to be adequate for growth and reproduction in our laboratories. One member of each litter mate group was given water to drink *ad libitum* and no dietary supplement. These animals were designated as Group A. The second litter mate was given a supplement each day of canned evaporated milk. These animals were designated as Group B. The third litter mate was given each day a supplement of chocolate and soft beverage. These animals were designated as Group C. The stock diet was available to all the animals at all times. The supplements were given the animals once a day.

The milk supplement which was given to Group B was equivalent to approximately 22 per cent of the average total caloric intake of each animal of this group. This percentage of the total caloric intake of the rat in the form of milk is comparable to a quart of whole milk in a child's daily diet of

2500 calories. Based on the daily caloric intake of the rat, a proportional amount of chocolate and soft beverage was given to the Group C rats. The supplement of chocolate and soft beverage was calculated on the basis of the ingestion of two chocolate bars and three soft drinks per day by a child of ten to 12 years of age. This amounted to approximately 24 per cent of the total caloric intake of the rats in this group. When the animals had finished drinking the milk supplement or the soft beverage supplement they were allowed free access to water.

The animals were continued on the experiment for a period of 20 weeks. The weight and food intake of each animal was recorded at weekly intervals throughout the experiment.

At the end of the experimental period, the animals were sacrificed and the liver, kidney, heart, and spleen were removed and weighed. The right femur was removed for measurement and analysis for calcium and phosphorus. The molar teeth were thoroughly cleaned and then examined under a dissecting microscope for decay.

The results of the experiment are given in the

** Purina laboratory chow.

accompanying table. There were no significant differences in the growth of the females. The male animals, however, that were given the supplemental feeding of either milk or chocolate and soft beverage gained more weight than their controls. This gain in weight is reflected in their greater total caloric intake.

The average weights of the liver, kidneys, heart, and spleen of both males and females show a good correlation with body weight indicating normal growth in these animals.

Supplemental feeding did not affect the calcification of the bones as determined by the calcium and phosphorus content. The larger the animals, the larger were the bones.

The results of the experiments reported here indicate that the supplementary feeding of milk and of chocolate and a soft beverage to rats eating an adequate diet does not have any adverse affect on the animals. The animals fed these supplements had normal growth curves, normal organ weights, normal calcification of the bones, and the same minor incidence of tooth decay as their litter mates fed only the stock diet.

The over-all plan of this experiment is somewhat too advanced to be used in the classroom since it involves chemical analyses of the bones and the weighing of the organs of the animals. A simpler experiment may be designed in which only the growth and development of a few litter mate groups are followed under the feeding regimes presented here. These observations on the growth and the development of the rats would show that good nutrition is compatible with the eating of foods consisting of or containing refined carbohydrates providing that an adequate diet is also eaten.

Another experiment which might be designed would be to feed the control animal a diet providing all the required nutrients in adequate amounts, and the test animal the same diet with the exception that one of the essential nutrients is omitted. This experiment would demonstrate the need of the animal organism for a particular nutrient. From this it could be reasoned that for good nutrition and good health we need a number of nutrients and these can be obtained only by eating a complete and well-balanced diet.

Animal experiments when carefully supervised by teachers indoctrinated in both scientific and humane principles may provide a valuable educational experience for children. While dramatizing the importance of good nutrition they also give the pupil an introduction into scientific procedures. But in order to accomplish this purpose, the experiment should be well designed and carefully supervised.

NATIONAL SCIENCE FOUNDATION SUMMER AND ACADEMIC-YEAR INSTITUTES

Expanding its program of grants for summer institutes, the National Science Foundation is making 1958 awards for high school and college teachers of science and mathematics at 108 summer institutes in 104 educational institutions. It is estimated that about 5000 high school and 250 college teachers will benefit from these teacher-training programs.

February 15, 1958 is the deadline for applications. A brochure listing the host institutions, the director at each, and the teaching fields of participants for whom the respective institutes are designed is being mailed out by the National Science Teachers Association early in January. As stated in this brochure, applicants should apply to the directors of the individual institutes and *not* to NSF or NSTA. However, teachers who do not receive a copy of the brochure by January 15 should write for it to NSTA: 1201 Sixteenth Street, N. W., Washington 6, D.C.

The 1958 grants total \$5,340,000. Ninety-nine of the institutes will be open only to high school teachers of science or mathematics. Four will be open to both high school and college teachers and five to college teachers only. Twelve institutes are offering courses in radiation biology.

The NSF grants cover costs of tuition and other fees for a specified number of teachers at each summer institute. Most institutes will pay stipends directly to participating teachers at a maximum rate of \$75 per week. Additional allowances for dependents to a maximum of four and for travel will be provided.

Academic-Year Institutes

The National Science Foundation is also continuing its program of academic-year institutes with grants to 17 colleges and universities for institutes to begin in September 1958. An estimated 800 high school science and mathematics teachers will be able to attend the institutes for personally-planned study as a result of grants totalling \$4,350,000. The grants will provide stipends of \$3000 each to about 50 teachers in each institute. Additional allowances for dependents and travel will also be provided.

The deadline for applications for the academic-year institutes is February 8, 1958. In this program, too, interested teachers should make application to the directors of the institutes. A brochure listing the 17 colleges and universities and the directors to contact is available from NSTA.

Classroom Ideas

Physical Science

A Science Project in Textiles

By SISTER HELENE VEN HORST and HELEN VEN HORST, Marycrest College, Davenport, Iowa

This experiment was undertaken as a project in a general course in the physical sciences for freshmen nonscience majors. It is described here chiefly for the purpose of giving some of the technique and procedure rather than from the point of giving the actual results. It is hoped that others will find it helpful for ideas in similar projects.

The topic was selected because of the junior author's interest in correlating textiles, her major, with physical science, a required course. The object of the experiment was to determine the effect of detergents on the stretch and strength of various kinds of thread. The results would then give some kind of knowledge of the effect of these detergents on fabrics of similar fibers.

Procedure

Four kinds of thread were used, namely, nylon, silk, and dyed and bleached cotton. A process of washing was devised on a small scale which nearly duplicated that carried out in an ordinary washing machine. Use was made of a hand mixer by removing one of the beaters permanently and by fastening the lid of a metal coffee can to the other. The outer edge of the metal lid was drilled with holes and wooden spindles were fastened by means of screws through these holes. (See Figure 1.)

In order to prevent any snagging, the wooden spindles were first wrapped with plastic and then wrapped with each of the various kinds of thread. Several spindles containing the same kind of thread were used so as to avoid excessive layers of thread on any one spindle. The wrapping was accomplished by fastening the spindles to the shaft of a hand-operated centrifuge. As the handle was turned, the spindle revolved and the thread was wound as on a spool.

In order to get reliable results, sufficient thread

of each kind was taken so that five samples could be analyzed for each set of washings. The average of the five samples was then considered as the result. In each case the samples being analyzed were removed from the spindle and the remainder of the thread on the spindle was subjected to additional washings. The process was continued until the samples of thread had been washed 50 times, or approximately the equivalent of one year of washings.

The washing process consisted of operating the modified mixer for a period of 15 minutes. The wash water was a detergent solution (1 gram/liter) heated to an initial temperature of 60° C. The

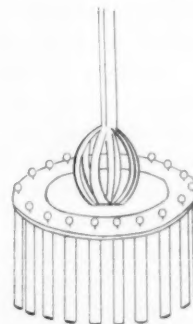


Figure 1. Mixer rotor with spindles attached.

rinsing process was accomplished in a similar manner. The rotor containing the spindles was removed from the detergent solution and rotated for three minutes in one rinse water and five minutes in another rinse water. After each of these complete washing and rinsing processes, the thread was thoroughly dried.

Drying the thread necessitated a dryer of some type. The problem was solved in this manner. Two large fruit cans, approximately three liters in size, were used. The bottom and top were removed and a large hole was cut in the side near the end of one of the containers. An electric heating coil was inserted in this opening. (See Figure 2.) The cans were wired together and insulated with asbestos. Circulation of the hot, dry air was brought about by mounting an oscillating fan at one end and inserting the mounted spindles of thread at the op-

posite end of the drying chamber. The temperature was held nearly constant at 60° C.

The drying process required approximately 15 minutes. The thread was then ready for another

Spindles on rotor inserted here.

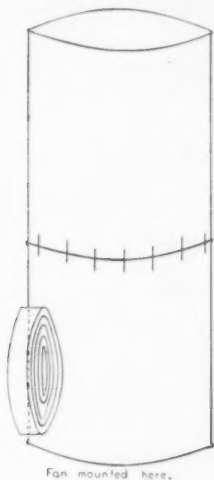


Figure 2. Drying apparatus.

washing and rinsing; or some of it was removed for measurement of stretch and strength, depending on the number of washings that had been made.

Determination of Stretch and Strength

The process of determining the stretch and strength of the thread was carried out in a room where the humidity was determined as ranging between 62 and 77 per cent. Since the strength of fiber varies with its moisture content, this factor seemed of sufficient significance to be considered.

A two-meter-long ruler was mounted in an upright position and permanently fastened to a hanger from which the thread could be suspended. Approximately one-meter lengths of thread were cut and suspended from this hanger. It was necessary to cut the threads instead of breaking them because the latter process damaged the fibers in the thread and thereby weakened them. A small, lightweight pointer and hanger were cut from copper plate and provided with two small hooks—one for mounting the thread at the bottom of the piece being tested and the other for suspending the weights. The initial length of the thread was recorded and then small weights were added until the thread broke. It was necessary to add the weights in small increments so as to avoid overloading the weights and thereby introducing an error in the measurement.

Results of these tests were tabulated in the following manner. The stretch in centimeters per centimeter was determined for each of five samples of

each thread at intervals of five complete washing, rinsing, and drying processes for a total of 50 of such processes. The results were then plotted as a function of the force used in stretching the thread. Further, the force required to break each kind of thread, after successive washing processes, was plotted as a function of the number of washings. Results were correlated and interpreted.

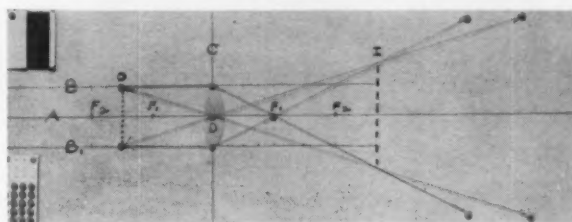
General Science

Geometrical Optics

By ROBERT H. LONG, Green Mountain College, Poughney, Vermont

If the teacher of general science or physics would like to get the construction work in geometrical optics off the blackboard and onto tables where students can do some manipulating along with the reasoning that goes into such work, the teacher might try this: With a piece of soft wallboard as a base, use elastic thread and heavy brads to construct the patterns (see photograph).

A large board, suitable for full-class viewing, can have permanent lines and letters for rapid changing of object distances and lenses.



Besides providing a different way of working out such problems, the apparatus makes it possible to easily readjust any lines that might not be properly located.

Elementary Science

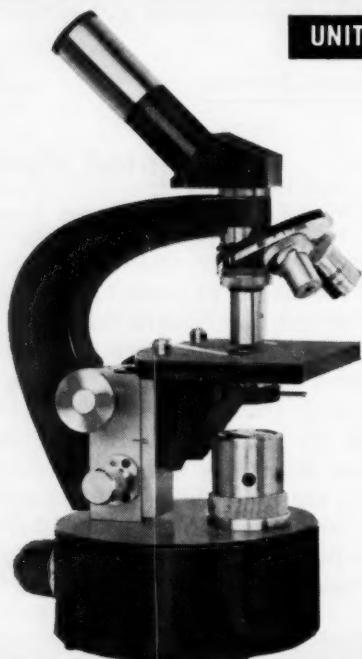
Air Takes up Space and Air Exerts Pressure

By M. IRA DUBINS, State Teachers College, Oneonta, New York

Equipment necessary for this demonstration is a hot plate, an aluminum pie pan about six inches in diameter and about $\frac{3}{4}$ of an inch in depth, a Pyrex dish whose upper diameter (or mouth) is

(Continued on page 401)

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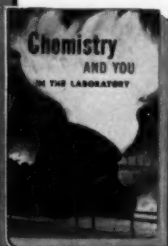
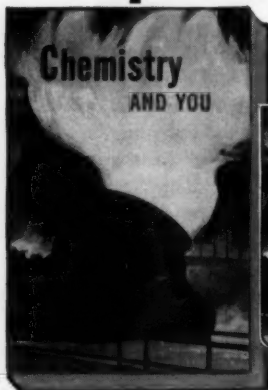
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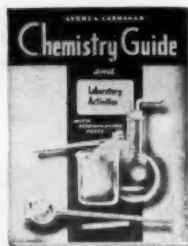
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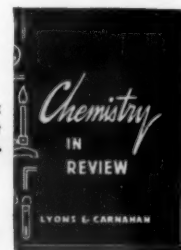
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(Continued from page 397)

about three inches and whose depth is about two inches, and a pencil stub.

The aluminum pie pan is put on the hot plate. Water is added so that the pan is almost full. The Pyrex dish is inverted and placed in the center of the pan. The pencil stub is placed so that one part of the Pyrex dish rests on it. Observe that there is no water in the Pyrex dish, although its mouth is below the water level. This is because the air present in the dish keeps the water out. Air takes up space and it must exert pressure to keep the water from entering. Later we will see that the pressure of the air forces water to enter.

Plug in the hot plate. Observe that as the water is being heated, bubbles of air escape and that the Pyrex dish is intermittently rocked slightly. These bubbles of air come from the air in the Pyrex dish because the air is heated and expands. Since there is no more room in the Pyrex dish the air moves out through the opening created by the pencil stub. As air is only very slightly soluble in water and lighter than the water and in motion, it moves to the surface of the water and escapes into the atmosphere.

Continue the heating until there are very few bubbles escaping. This means that most of the air has escaped from the Pyrex dish. Remove the plug. Observe that as the water begins to get cooler, it starts to enter the Pyrex dish. After several minutes the water level in the Pyrex dish will exceed the water level in the aluminum pie pan. The water level within the dish will continue to rise depending on how much air was expelled.

As the water cools, the air within the Pyrex dish also cools, and at the same time it contracts, permitting water to enter. The air pressure within the Pyrex dish at this time is less than the pressure of the air outside the dish. When the demonstration started the pressure was the same, because no water entered the Pyrex dish even though its mouth was below the surface of the water. However, air was lost as we saw when the air bubbles left the water. When the water cools and the air cools and contracts, the air pressure within the Pyrex dish becomes lower than that outside, so the atmosphere pushes water into the dish.

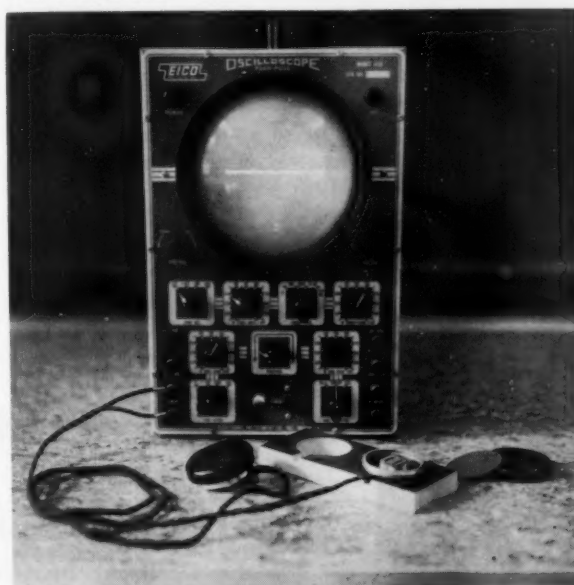
This demonstration offers an excellent situation for problem solving. Ask the students to explain why the water level is higher inside the Pyrex dish than outside, what happened to the air which was inside the Pyrex dish at the beginning of the demonstration, what determines the water level inside the Pyrex dish, and what the purpose of the pencil stub is.

Physics

Projecting Sound Waves and Beats on the Oscilloscope

By BROTHER H. GREGORY, De La Salle High School, Minneapolis, Minnesota

Voice waves are fairly easy to project on the oscilloscope, but tuning forks, because of the low intensity of the sound, produce a pattern visible only to the closest observers in a class. However, with the following system both voice and tuning fork patterns as well as beats can be satisfactorily demonstrated.



The connected equipment

Connect the terminals of a set of magnetic-type earphones to the "vertical plates" of the oscilloscope. Set the sweep frequency (horizontal plates) to approximately equal that of the voice or tuning fork. Applying the fact that an earphone can be used as a microphone, speak into one phone to project the sound waves. Remove the cover and diaphragm of the other phone for use with the tuning fork. Here the vibrating tip of the tuning fork is held above the small magnet in the phone, inducing a current of the same frequency as the sound wave. Beats can be projected by removing the cover and diaphragm of the other phone and holding a fork over each. Of course this procedure is limited to steel tuning forks, as aluminum, the other common material, does not cause the magnetic field to fluctuate.

SNYDER . . . from page 379

at various times in the life history of an individual.

As a final instance of the acquisition of rationality by an intuitive foundation stone, let us consider the self-duplication of genes and chromosomes. There is no doubt that these structures become duplicated at every cell division, but calling the process self-duplication has never explained it. Early accounts of mitosis spoke of the chromosomes as splitting down the middle, the two halves separating and then growing to full size. Later accounts visualized the genes as building exact replicas of themselves alongside of themselves.

It has always been realized, however, that genes are complex molecules, and it has been difficult to understand how an asymmetrical structure could duplicate itself without producing a mirror image of itself rather than an exact copy. Recent advances in biochemistry have opened new vistas in this direction, as they have in so many others. The remarkable work of Watson, Crick, and their colleagues in England indicates that genes are probably complicated molecules of desoxyribose nucleic acid, bound up with the proteins of the chromosome as highly polymerized nucleoproteins. Although it has been suggested that the order of the sequence

of the bases in the nucleic acid might account for the specificity of the gene, this concept has been questioned. The folding and assembly of large nucleoprotein molecules is thought to be also involved in specificity, which is probably not fully determined by the sequence either of bases in nucleic acids or of amino acids in proteins.

It is obvious that a surface is required to produce a surface, and it is through surfaces that enzymes and antigens act specifically. Kacser has recently given much thought to this problem, and has offered a working hypothesis to account for the auto-synthesis of genes and chromosomes.

In Kacser's opinion, both the protein and the nucleic acid contain specific surfaces and in fact constitute an adsorption complex. In order that the physical entity be duplicated and the functional properties be replicated, both the nucleic acid and the protein must be recreated in cell division. An absorption complex between protein and nucleic acid is visualized, with an interface between them. This interface constitutes the functional part of the macromolecule. The forces acting at the interface are considered to be mainly van der Waals and coulombic forces. Such forces are very specific, depending strongly as they do on the nature of the two surfaces. In this respect they are unlike hydrogen



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bonds. They are short range in nature, and require a very close approach for any partial absorbate.

The chromosomes and their genes are thus to be thought of as two-parted structures, protein and nucleic acid, joined by an interface; each part being the complement of the other. Kacser assumes the external surface of the double structure to be "denatured," so that only interface surfaces can initiate new solid-phase formation.

It is likely that desorption would on occasions cause the interface to open at one point or another along the chromosome, but it would probably remain open for any length of time only at one end or the other. An open end, with the two parts separated, could give rise to the construction of a complementary structure against each half. This would provide a precisely fitting surface against each separated face, with a separation always ahead of the new construction. The process could then proceed in zipper fashion along the chromosome.

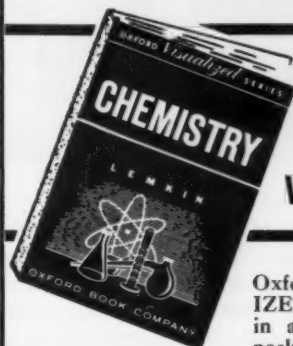
The result of such chemical maneuvering would be the formation of two structures, one consisting of "old" protein and "new" nucleic acid, the other of "old" nucleic acid and "new" protein. Kacser's suggestions thus provide a rational biochemical hypothesis for the duplication of a solid structure, with concomitant replication and preservation of a specific functional interface.

It is stimulating to live in the actively-developing phase of a science. If we can transmit to our students some of the intellectual stimulation which we as teachers continually experience, perhaps we can increase our effectiveness in overcoming the ominous shortage of scientists and science teachers.

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6th NATIONAL CONVENTION OF NSTA

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The "big name" news is beginning to break for the Denver convention program. The speakers, the interests they represent, and their subjects portend a varied program stimulating to all science teachers and up-to-the-minute in relation to the science news which is headline material now.

Dr. Margaret Mead, the distinguished anthropologist, will be the speaker at the annual banquet, which will take place Thursday evening, March 27. Her topic will be "Bringing Science to Life." An author as well as an anthropologist, Dr. Mead is widely known in non-scientific as well as scientific circles. She has been on the "best-seller" list and her books include "Male and Female, A Study of the Sexes in a Changing World," "Coming of Age in Samoa," and "And Keep Your Powder Dry." She is also co-author, with Frances Macgregor, of "Soviet Attitudes Toward Authority" and co-author, with Rhoda Metraux, of the article, "Image of the Scientist among High-School Students," a report on a pilot study published in the August 30, 1957 issue of *Science*.

Associate curator of the American Museum of Natural History in New York City since 1942, Dr. Mead had previously held the post of assistant curator of ethnology at the museum for 16 years. Her career has taken her to far corners of the world; currently she is on an extended trip in the South Pacific.

Dr. Elbert P. Little is another science personality of distinction who will be at Denver. He is executive director of the Physical Science Study Committee, headquartered at the Massachusetts Institute of Technology, Cambridge, which is making a study that portends possibly revolutionary advancements in the teaching of secondary schools physics. (See the November 1957 issue of *The Science Teacher*, which features a four-article report on this study.) He will be chairman of a two-session Curbstone Clinic titled "The Physical Science Study: an experiment in the redesign of high school physics." The Curbstone Clinics are scheduled for Thursday, March 27.

Saturday's (March 29) luncheon, sponsored by the Colorado Science Teachers Association, will feature a talk by Ernest Stuhlinger of Redstone Arsenal, Alabama. His topic will be "Space Travel and Science Education."

The speech at the opening general meeting, Wednesday (March 26) afternoon, will be made by Dr. Glenn Blough, associate professor of education at the University of Maryland, College Park, current president of

NSTA. His topic will be "What Constitutes Effective Science Teaching?"

Among other stellar names on the program—and there are still more to come—are:

Dr. Rose Lammel of Wayne University, Detroit, Michigan; scheduled to speak at the Wednesday evening general meeting, she will talk on "What Constitutes an Effective Science Program?" Dr. Kenneth Oberholtzer, superintendent of the Denver Public Schools; he will be a moderator at the Thursday morning general meeting on the subject, "What Are the Characteristics of a Good Science Teacher?" Dr. Duane Roller of the University of Oklahoma, Norman; speaking at the Friday (March 29) afternoon general meeting, he will talk on "How Can We Use the Knowledge of Current Science to Improve Science Teaching?" Dr. Paul DeH. Hurd of the School of Education, Stanford University, Stanford, California; speaking at the Saturday morning general meeting, he will discuss "What Constitutes Effective Use of Instructional Materials in Science Teaching."

The Daily Themes

The theme of the convention is *Improving Classroom Science Teaching* under which four sub-themes for each day have been developed. Wednesday's is *Through Sequential Science Programs*; Thursday's is *Through Effective Science Teachers*; Friday's is *Through Research in Science and Science Teaching*; and Saturday's is *Through Better Educational Tools and Materials*.

There is more definite news now, too, on the Curbstone Clinics. A final list of 29 tentative questions and topics was drawn up, from which a selection of 22 has been made. Twenty-five of the tentative list were printed in the November issue of *TST* (page 347). The four which were added, and all of which are now on the program, are: Needs and opportunities for improved pre-service education and certification of teachers in science; Training and effective use of elementary science consultants, etc.; Planning specific classroom science experiences for the primary grades; and Planning specific classroom science experiences for the intermediate grades.

The clinics are scheduled for morning and afternoon sessions on Thursday. Those on several topics, such as The Physical Science Study, will meet for both sessions. The others will be programmed for either a morning or afternoon period.

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Shell Merit Fellowships will be awarded to fifty selected participants at each University to attend 1958 summer leadership training programs for secondary school chemistry, mathematics, and physics teachers; supervisors of science or mathematics, and department heads.

Purposes

The purposes of the University programs are the same; namely, to provide recognition for and specialized help to individuals who are demonstrating the qualities necessary for distinguished leadership in the improvement of science and mathematics teaching in secondary schools. The programs will provide experiences and studies that will help such persons to improve their own work and to develop ways and means of assisting other teachers in their school, community, and region.

Objectives

The ultimate objectives are: (1) a greatly increased number of citizens well informed about the role of science and mathematics in human affairs, and (2) expanded opportunities for promising youth to secure adequate secondary school preparation for the beginning of studies pointing toward careers as scientists, mathematicians, engineers, and teachers.

Programs

The programs will include courses, special lectures, discussions, visits to research and production establishments, and informal interviews with outstanding scientists, mathematicians, and educators. Those selected will be expected to pursue one or more projects related to instruction in their subject area and pointing toward leadership efforts in their own community.

Eligibility

Teachers who are at least in their fifth year of high school teaching in chemistry, mathematics, or physics; who have good leadership ability; and who have the prospect of many years of useful service in the improvement of chemistry, mathematics, or physics teaching are eligible. Heads of departments and supervisors with good preparation in chemistry, mathematics, or physics who formerly were teachers in one or more of these fields are also eligible. An interest in further studies in one or more of the indicated subjects will be expected. Evidences of leadership potential will be significant factors in the selection.

Awards

The closing date for mailing application materials is February 1 and all who apply will be notified in February. The persons who are selected by each University and who accept a Shell Fellowship will receive free tuition, fees, books, board and lodging, and a travel allowance. Each will also receive \$500 to help make up for the loss of other summer earnings.

Information

Inquiries from teachers east of the Mississippi should be directed to Dr. Philip G. Johnson, 3 Stone Hall, Cornell University, Ithaca, New York. Interested teachers who reside west of the Mississippi should write to Dr. Paul DeH. Hurd, School of Education, Stanford University, Stanford, California.

NSTA Activities

► Time to Renew

December 31 is the terminal date for NSTA services to 1957 members who have not by then renewed their membership for 1958. These services include the subscription to *The Science Teacher*, the Packet Service, and the many other aids that NSTA provides.

NSTA membership is a mutual affair. Deriving its strength from the support of science teachers, the Association has been able to expand its whole effort and plans to continue doing so. Particularly in these times when world citizenry has become science conscious, NSTA has developed into one of the real fountainheads of information and advice for both individuals and groups seeking to improve understanding, appreciation, teaching, and knowledge of science.

It was a difficult decision that was made by the Board of Directors last summer when NSTA dues were increased. But the fact had to be faced that if the Association was to continue as an effective service organization, it could only afford to do so if the members were contributing the true value for "goods and services received." Actually, NSTA's current membership rates are in line with those of other professional organizations; in some cases, even lower.

So if you're one of those "I'll do it tomorrow" people and have not yet sent in your renewal check, this is one time to make yourself "do it today." The demands of the times are such that every science teacher who can possibly afford it should include NSTA in the roster of professional groups to which he or she belongs.

► Yearbook Committee

It has taken a lot of careful and painstaking planning but it promises to "pay off." This is the formation of the yearbook committee which was authorized by the Board of Directors at the 1956 summer meeting at Corvallis, Oregon (see September 1956 TST, page 247). The committee's job is to work with the National Society for the Study of Education (NSSE) in the preparation and publication of an NSSE yearbook on timely and significant aspects of science teaching.

The committee is now actually an NSSE group. Its chairman is Dr. J. Darrell Barnard of New York University, New York City. The other NSTA members are: Dr. Glenn O. Blough, University of Maryland, College Park; Dr. Paul DeH. Hurd, Stanford University, Stanford, California; Dr. Ellsworth S. Obourn, U. S. Office of Education, Washington, D. C.; and Dr.

John S. Richardson, The Ohio State University, Columbus, Ohio. Serving with them in a more or less ex-officio capacity and representing their respective organizations are Dr. Robert J. Havighurst, University of Chicago, Chicago, Illinois, for NSSE and Robert H. Carleton, executive secretary of NSTA.

It is a tremendous task which faces this group in the light of the numerous and sometimes conflicting opinions on science education today. The committee is now at work developing outlines for the content and design of the yearbook. It is expected to require at least a year and a half for the writing and publishing of the book. Early 1960 is now the anticipated publication date.

This will be the fourth yearbook devoted to science education in the NSSE series. Even though it is ten years since the last NSSE yearbook relating to science education, it is interesting to note how the time gap is narrowing. The first publication was the Third Yearbook, Part II, dated 1904, and titled "Nature Study." The second was the 31st Yearbook, Part I, published in 1932, and reporting "A Program for Teaching Science." The third was the 46th Yearbook, Part I, published ten years ago; it dealt with "Science Education in American Schools."

All three of these are considered landmark documents in the history of science education in the United States and have had strong influence on science teaching techniques and practices. It seems inevitable that the forthcoming yearbook will be equally if not even more significant and influential.

► STAR Deadline

Anything beyond the Christmas holidays may seem now to be the hazy future, but this is not true about the deadline in the 1958 Science Teacher Achievement Recognition (STAR) awards program. The deadline for entries is February 15, 1958 and considering the amount of careful thought and work which should go into an entry, now is the time to be active on at least one.

The specific theme for STAR 1958 is effective practices in the laboratory teaching of science. Awards totalling \$6750 will be made to 50 teachers for reports on such practices. The plan is to announce the winners at the NSTA 6th National Convention in Denver, Colorado, which will meet from March 26 through 29, 1958. Teachers who have not received STAR entry blanks should write for them immediately: NSTA, 1201 Sixteenth Street, N. W., Washington 6, D. C.

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FSA Activities

► Research Grants

An FSAF milestone has been reached with the announcement of the first grants under the new on-the-job research program. Four have been made after considerable review on the part of the FSAF subcommittee in charge of the program.

The grants are to: George W. Hosker and Richard N. DiLorenzo (one grant for a joint project) of Memorial High School, Valley Stream, New York. Their project is "The Collecting of Protozoa and the Investigation of Their Suitability for Research." Mrs. Ethelreda Ross Laughlin of Cleveland Heights High School, Cleveland Heights, Ohio. Her project is "The Study of the Nitrogenous Constituents of the Blood, Especially Those Making Up the 'Rest' Nitrogen."

Richard Salinger of Wilton High School, Wilton, Connecticut. His project is "The Role of the Reticuloendothelial System (RES) in Protecting Animals Against Bacterial Toxins." Robert L. Walker, Lyons Township High School and Junior College, La Grange, Illinois. His research subject is "Water Evaporation Rate Control."

In announcing the first four grants, the FSAF subcommittee reported that a variety of unusual and interesting research projects were submitted, showing a considerable amount of planning preparation as well as the deep interest of science teachers in doing on-the-job research. This is a professionally satisfying development, the sub-committee said, since the program was originally authorized by the FSAF Administrative Committee in the belief that science teachers need to and want to carry on research while teaching. In addition, on-the-job research usually involves the help of able students who thereby have the often rare opportunity to take part in scientific research in addition to their normal classroom activities. This has also been found to be a stimulant toward interest in science careers among the student research assistants.

As one of the pioneers in this type of grants program, FSAF hopes to continue and expand its activities in this field. All high school science teachers who might be interested are invited to submit proposals for research projects they would like to carry out on the job. The applications should include full details of the problem, including the budget for doing the work. Guideline data for filling out the applications is available at FSAF: 1201 Sixteenth Street, N. W., Washington 6, D. C.

The committee is now planning a spring meeting,

probably about May 1, to review applications in the hope of being able to make additional grants. The financial ability to do this will depend largely on the extent to which business-industry supports FSAF during 1958.

► Roster of Sponsors

There have been additions to the 1957 roster of sponsors of the Future Scientists of America Foundation since the last listing in the September 1957 issue of TST (page 239). The roster now includes 56 business-industry organizations which have made financial grants to FSAF during this calendar year. The grants total approximately \$88,000.

Commenting on this figure, Robert H. Carleton, NSTA executive secretary and a member of the FSAF Administrative Committee, said: "By itself, the sum of \$88,000 is not unimpressive. However, two factors must be taken into consideration. One is that, in addition to general programs, this amount includes financing of the three summer institutes co-sponsored by FSAF in 1957 as well as the 1957 program of Science Achievement Awards for Students—a total of about \$60,000. More important, however, is the fact that FSAF has one single purpose: to encourage future scientists in America. Certainly there is no more paramount problem today. Business-industry is as much aware of this fact as officials in Washington and even the man on the street. Considering the success of the various facets of the FSAF program to date—limited as they are by financial restrictions—it seems essential that the FSAF roster of sponsors must be tremendously increased as must be the amount of the financial grants made to the organization."

Following are the 1957 sponsors not previously listed in TST.

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Book Reviews

SCIENCE AND THE SOCIAL STUDIES. 27th Yearbook of the National Council for the Social Studies, 1956-57. Howard H. Cummings, Editor. 271p. \$4.00 paperbound, \$5.00 clothbound. National Council for the Social Studies, National Education Association, 1201 Sixteenth Street, N. W., Washington 6, D. C.

The 27th Yearbook of the National Council for the Social Studies is the fruit of an ambitious project. Congratulations must go to the editor and the various authors for a most creditable job. The publication of the Yearbook just this past summer is indeed timely. Many pointed suggestions have already been voiced that the social studies teacher must share with the science teacher the task of raising the level of public understanding regarding the nature of modern science and technology and their social and political significance. In this sense, the present Yearbook is a distinct contribution to education and this applies at both the policy and action levels.

While aimed at the social studies teacher, the Yearbook contains much of interest and importance to the science teacher. There are technical chapters dealing with scientific research in agriculture, medicine, and atomic energy, which incidentally are quite good, and discussions of scientific research in the United States and the National Science Foundation. The chapters on science and social studies in the elementary and secondary schools were written by well-known science educators and it is good to have these views in the context of the present Yearbook. They are timely as well as pertinent.

Perhaps more significant to the theme of the Yearbook and to interested educators are those chapters in which an attempt is made to analyze the relation of science to society and thus to the social studies program. It has always seemed to this reviewer that any fundamental and effective liaison between science and the social studies at the teaching level must rest on a thorough analysis of science in a social setting and in a social order. This emphasis on the sociology of science does not preclude the need for scholarly attention to the history and philosophy of science. Indeed, it is imperative to do so if the analysis is to be complete. Although no claim of completeness is made for the sociological analysis as here presented, it may be pointed out that the importance of the history and philosophy of science have not been overlooked in the Yearbook.

Finally, there is discussion of the education of the teacher of social studies with respect to the problems and proposals raised in the Yearbook. Here we have an analysis with which most science teachers will agree, up to the point where the question of the competency of the social studies teacher in science is raised. It is doubtful that present programs in science offered in teacher training and liberal arts colleges for the nonscience student are, as is suggested in the chapter on teacher education, adequate for the preparation of today's social studies teacher, especially when his job is reassessed in relation to the points of view developed in the present Yearbook.

It is the opinion of the reviewer that the 27th Yearbook

of the National Council for the Social Studies is a significant contemporary document highly worthy of study by the science teacher. It is a book, too, which should be kept on the reference shelves.

HUBERT M. EVANS

*Teachers College, Columbia University
New York City*

BOOK BRIEFS

SCIENCE IN EVERYDAY LIFE. Ellsworth S. Obourn, Elwood D. Heiss, Gaylord C. Montgomery. 632p. \$4.68. D. Van Nostrand Company, Inc., Princeton, New Jersey. Publication date January 2, 1958.

Second edition, updated, timely, of comprehensive survey of applications and affect of science in everyday living. Contains nine broad unit areas from "Learning to Solve Problems in a World of Science" to "Energy—From Atoms to Stars." An activity book, handsomely illustrated in color and black and white.

SOVIET EDUCATION FOR SCIENCE AND TECHNOLOGY. Alexander G. Korol. 513p. \$8.50. The Technology Press, Massachusetts Institute of Technology, Cambridge, and John Wiley & Sons, Inc., New York. 1957.

Report on an appraisal of an educational system about which every knowledgeable person is now curious. Detailed, factual. The author, Russian-born U. S. citizen, is now at M.I.T.

BRAINPOWER QUEST. Edited by Andrew A. Freeman. 242p. \$4.75. The Macmillan Company, New York. 1957.

Symposium of opinions stated by leading American scholars, scientists, philosophers, and men of affairs at an October 1956 convocation sponsored by The Cooper Union for the Advancement of Science and Art.

BETTER BIOLOGY FOR HIGH SCHOOL. D. K. Gillespie. 235p. \$3.50. Vantage Press, Inc., New York. 1957.

Syllabus-text by a high school biology teacher written with help of suggestions, criticisms from his students. Includes practical laboratory work.

ON NUCLEAR ENERGY. Donald J. Hughes. 263p. \$4.75. Harvard University Press, Cambridge, Massachusetts. 1957.

Adult-level survey of development, fundamentals, potential peacetime uses of nuclear energy. Should challenge able high school students.

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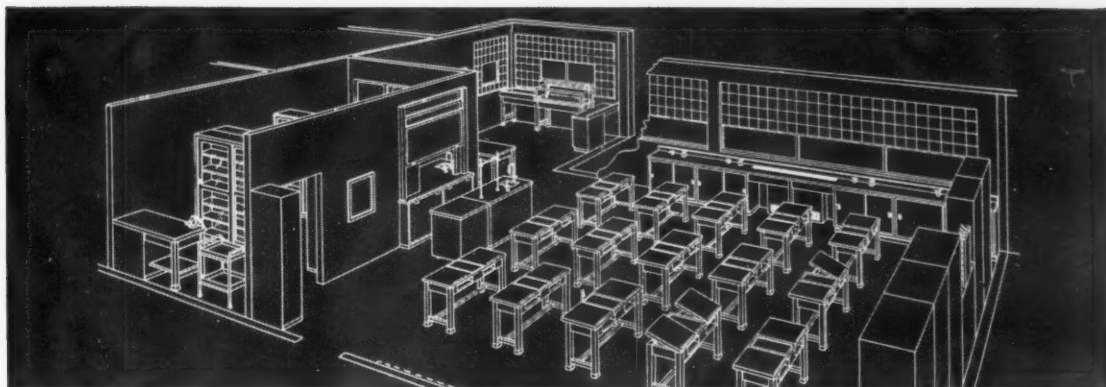
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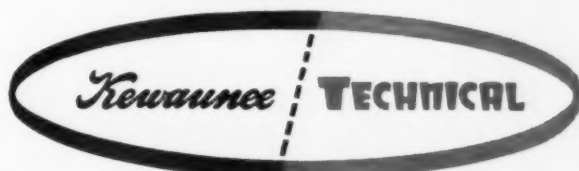
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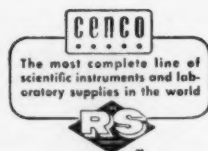
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